The Electrical World.

VOL. XXIX. NEW YORK, FEBRUARY 27, 1897. No. 9.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave, Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXIX. NEW YORK, FEBRUARY 27, 1897. No. 9.

CONTENTS.

Editorial 279
The Berliner Microphone Case, by E. F. Frost 281
Electric Motive Power on the New Haven Road 282
The Two Great Science Associations, by William H. Hale 282
Electricity on the Manhattan Elevated Railways 283
Prof. Galileo Ferraris, by Henry S. Carhart 284
Alternating Current Machinery—V, by Edwin J. Houston and A. E. Kennelly 285
Twenty-fifth Anniversary Celebration of the Stevens Institute of Technology 287
On the Deflection of Cathode Rays, by James Mark Barr and Charles E. S. Phillips 289
Interior Conduits 289
The Enclosed-Arc Lamp, by R. M. Hunter 291
Digest of Current Electrical Articles, compiled by Carl Hering 292
New Book 296
Easy Inspection of Large Generators 296
The A. E. G. Incandescent Lamp 297
Bug Cut-out 297
"Duo" Packing 297
Alcohol Torch 297
Centre Vestibule Car 298
The Manufacture of Tubing 298
Side Crank Medium Speed Engine 299
New Incandescent Arc Lamp 299
Electric Bicycle Lamps at the New York Cycle Show 299
Departments:
Financial Intelligence 301
Special Correspondence 301
General News 303
Personal Notes 304
Legal Note 304
Trade and Industrial Notes 304
Business Notices 305
Illustrated Record of Electrical Patents 306

ELECTRICITY ON NEW YORK ELEVATED ROADS.

The present consideration of electric traction by the directors of the Manhattan Railway Company of New York City will apparently result in the electrical equipment, eventually, of all roads of the elevated system. While this subject is perennial and has been a theme for discussion off and on for more than eleven years, it seems that at last some action will be taken and that a change will be made in the motive power. Under present conditions the limited capacity of the roads is nearly reached, despite the opposition of numerous cable and other surface roads. Aside from its objectionable features, the noise, dirt and smoke, that have been endured for so many years in this city, the steam locomotive presents in contrast with the electric motor so great a deficiency in economy that this consideration must inevitably compel its retirement in favor of the more modern method.

The question to be decided by the Manhattan directors is not whether electricity should be used, but in what way it should be used. The direct-current motor for railway use is a very satisfactory and efficient machine, while there is apparently no reason why the polyphase-induction motor should not become a most formidable competitor under the conditions presented. The principal point to be settled is whether the electric motor shall replace the locomotive, and draw behind it a train of cars as in the present method, or whether each car shall be equipped with motors in the way originally described by Mr. Frank J. Sprague. This latter plan provides a more flexible and seemingly more intelligent solution, and has the advantage of having been thoroughly and successfully tested on other roads. It is by no means unlikely, however, that some radical departure from existing methods may prove to be the most efficient and satisfactory solution. Should the directors decide to use electricity, the occasion will present to American engineers one of the greatest opportunities they have yet enjoyed. No one who has watched the magnificent development of the electric railway in this country will doubt the ability of our engineers to make a signal success of this great installation, but it is to be hoped that the Manhattan Company will be guided by wise counsels in their choice of a system.

STEVENS INSTITUTE OF TECHNOLOGY.

A quarter of a century is but a brief period in the life of a university even in our own country, but in the life of a technical school it means dating back to the comparatively early beginnings in strictly technical education as distinguished from the classical courses pursued in other seats of learning. Although Stevens Institute of Technology was not founded as far back as some of the institutions of a similar character, its twenty-five years of existence has placed it among the first of the technical schools, and the general excellence of its courses and the ability of those who direct its policy are evidenced in its list of graduates who are now holding leading positions in many branches of engineering, chemistry and other pursuits requiring a theoretical training combined with a practical ability to apply it. Although almost strictly a school of mechanical engineering, the instruction given in electricity, combined with the fact that a thorough grounding in mechanical engineering has in the past proved of the greatest value to engineers taking up electrical pursuits, have been the chief causes for the influence which this institution has exerted in the electrical profession. Now, however, that purely electrical courses have been established in various colleges throughout the country, and owing to the natural tendency for those seeking instruction in electricity to attend

such institutions, the influence of the past which mechanical engineering has exerted upon electrical engineering is not likely to be so noticeable in the future. Notwithstanding this fact, the principles underlying mechanical engineering cannot be separated from engineering in its broadest sense, and for this reason there will be a development on still broader lines, even though the student ultimately narrows down to some special branch of his profession. Electrical and mechanical engineering will, therefore, continue to go hand in hand, exerting a mutual influence one upon the other, so that such institutions as Stevens will undoubtedly add in the future still greater benefits to the broadening field of industrial development, and at the same time increased honors to themselves.

INTERIOR CONDUITS.

In other columns of this issue will be found a few of many opinions received from practical engineers and manufacturers regarding the type of interior conduits which should, in their opinion, be used in the installation of electrical conductors in buildings. Other replies will be published in a subsequent issue. As will be found upon reading the communications, those who have expressed their opinions differ radically in their views; some advocating absolutely bare pipes to be used with the best quality of insulated wires, while others favor a lined tube which will at the same time offer an additional safeguard in maintaining the insulation resistance. The excellent results combined with the thorough practicability of existing methods of conduit construction, leaves little to be desired but a reduction in first cost. Whether equally good results can be obtained by employing less costly forms of tubing is the question open for discussion. Taking a broad view of the subject, it seems apparent that existing practice is but in a tentative stage, and the fact that provision is made for drawing conductors in and out simply means an acknowledgment on the part of electrical engineers that a larger factor of safety is required than would obtain if a fixed system were employed. There is little room to doubt that electric construction will ultimately be considered as reliable as pipe-fitting for either gas, water or steam supply, and there will be no more necessity for replacing a conductor than for changing the size of a pipe used for such purposes. To advocate such a system at this time would be premature, but it is not without interest, value and practical importance to consider what will be the probable method of transition from the present state of the art to that which promises to place interior electrical distribution on a most economical and at the same time reliable basis.

CARBON INTO ELECTRICAL ENERGY.

The few who attended the meeting of the New York Electrical Society on Wednesday of this week listened to a very instructive paper on "Electricity from Carbon without Heat," presented by Mr. Willard E. Case. In speaking of the carbon cell recently revived by Mr. Jacques, Mr. Case added little toward explaining the curious results which are obtained in this form of battery. He finds that if water is present with caustic soda when first used, the reversion of the electromotive force which Mr. Reed found to exist becomes manifest, and he believes that its presence is the cause for this phenomenon, similar in its nature to that which takes place in the case of a thermo-electric couple. If caustic soda is fused in a nickel crucible, the nickel is not acted upon by the caustic, and therefore acts as an inert negative. Under these conditions no reversal of polarity could be detected, but as the temperature is increased the electromotive force rises to a maximum and then diminishes, finally becoming apparently asymptotic to the temperature axis. This fact is opposed to that presented by Mr. Reed, who found a reversal of the electromotive force as the temperature increases. The discrepancy may possibly be explained upon the assumption that the radiation of heat from a nickel crucible in Mr. Case's experiments is sufficient to prevent an increase of temperature above a certain point. The erratic performance of the cell in which an iron vessel is employed clearly showed that there remains considerable room for investigating the action of this type of carbon battery. One of the most interesting and suggestive points which Mr. Case brought out is the possibility of discovering a method of obtaining electricity from carbon without heat, by following nature's plan in the human system, and instead of having the entire transformation take place within the carbon-conveying cell, previously prepare outside the cell the material to be used.

RULE-O-THUMB ELECTRICAL ENGINEERING.

A remarkable statement was made a few days ago by President Clark, of the New York, New Haven & Hartford Railroad Company, before a legislative committee in Hartford, Conn., touching the experience of that company with the introduction and use of electric motive power on one of its branch lines, and the proposed future extension of the same system on another branch. What arrests the attention of electrical engineers most in Mr. Clark's remarks is his apparent disregard for technical electrical knowledge in planning an undertaking of the kind under consideration. According to his own story, Mr. Clark set up his own inexperience against the knowledge of trained engineers, and ignored their recommendations in favor of his own rule-o-thumb engineering ideas. Mr. Clark states that electrical engineers are amazed that the third-rail system on the Nantasket Beach line works at all with no other insulation than wooden blocks. The fact is, wooden blocks, treated as they are in this case, form very good insulators; so, after all, there is nothing particularly wonderful in the fact that the line works as well as it does. Another favorable element is the size of the third rail, which is of low resistance, and, no doubt, favorable conditions of soil, etc., aid to some extent in the attainment of the general good results. These results do not reflect any discredit upon the electrical engineering skill which Mr. Clark had at his command. Neither he nor any one else can deny that electrical engineering as a science is as susceptible of exact calculation as is steam engineering or any other branch of engineering science.

Apart from the reflection upon his electrical advisers, Mr. Clark shows himself to be a deep-dyed enthusiast on the subject of electric power on railway lines. He even mentions the possibility of relegating his locomotives to that graveyard of ruined and obsolete mechanisms—the scrap heap. But before he undertakes to accomplish this result, we think he should listen to the advice of his engineers. The application of electric power to this class of work has its practical limitations, which no one can afford to determine in a haphazard fashion. In all engineering undertakings there are laws and principles that cannot be violated, and in order to apply them to produce the most efficient results, the advice of those who are familiar with them is absolutely indispensable.

The Lower Prices of Steel Rails.

The recent break in prices of steel rails comes at a timely season for street railway extensions and construction enterprises, and will prove an additional stimulus to such undertakings. Construction operations are already under way in the Southern States, and the season will be sufficiently advanced by the end of next month for such work in all parts of the country. A careful study of the market reports just now will prove both interesting and profitable to street railway men who are contemplating track extensions.

Dehydrating Alcohol.

According to some researches of Biernacki, in a German physical journal, alcohol containing water may be deprived of its water by dipping into it amalgamated aluminum. Aluminum may be amalgamated by connecting it to one pole of a battery and repeatedly dipping it into mercury which is connected to the other pole. The spark produced upon withdrawing it yields sufficient heat to bring about the amalgamation.

The Berliner Microphone Case.

BY E. F. FROST.

From a perusal of the recent editorials and articles in your columns discussing the telephone situation it is clear that there is a fundamental misconception of the Berliner case as to its position before the United States Supreme Court, and that because of this misconception most of the points raised and discussed seem to me to be wholly beside the question.

The case as it rests before the court hinges on three counts for decision.

First: Has the Government the power to bring suit to annul its grant?

Second: Was fraudulent delay connived at by the defendant in the prosecution of the application?

Third: Are the two patents to Berliner of 1880 and 1891 identical?

The whole case rests there, primarily on the decision of the first count.

If it be decided that the Government has no power to bring suit to annul its own grant, then the second and third counts will not be considered.

It is the general opinion among the legal profession that the Government has no power to bring such suit, and therefore it is expected that the Government will be completely defeated on the first count.

On this count the Government submitted, in supplementary brief and in argument, its reasons for its right to bring such suit, wholly relying on the unquestioned power of the Government to bring suit to recover grants of land obtained through fraud or mistake. But the question must be decided as to whether a land grant and a patent grant are of the same nature, and to be made and recovered under the same laws.

In issuing a land grant the Government transfers to the grantee property of which it was itself invested, and if such grant was obtained by fraud or mistake either on the part of the grantee or the Government, in bringing suit to recover the same, the Government is attempting to recover its own property. Many decisions have determined the Government's right to do this.

On the other hand, in issuing a patent grant, the Government has parted with no property of its own in which it was itself invested, but has simply issued to the patent grantee a privilege to the exclusive right to the grantee's own property.

If now by fraud or any other mischance the Government issue a patent grant to a grantee to the exclusive use of some one else's property, does the power to bring suit to annul such grant reside in the Government?

To illustrate: Suppose A sell B a horse and bring suit to recover the same on the ground that the horse belonged to C. B would naturally question A's right to bring suit to recover from him another's property.

If the Government has shown that it has granted its own property to Berliner and that it had no right to do so, then the court may decide that the Government may bring suit to recover the same.

In the Berliner case the only evidence set up by the Government that tends to show a Government property wrongfully granted by the Berliner patent of 1891 is its contention that the Bell transmitter of 1876 is inclusive of the Berliner patent, and that the Government's property in the said Bell transmitter resides in the reversion of the same to the public by reason of the expiration of the granted privilege to Bell.

But would not the Government take strong ground in contending that it had prospective property rights by reversion at the expiration of a patent grant?

If the court should hold that the Bell transmitter is not inclusive of the Berliner and that the Government has no right to bring suit to annul the Berliner patent, then the Government's case falls without consideration of the second and third counts of the case.

But, if the Government issued to Berliner another's property, then that other may successfully bring suit to recover.

Although the Government has set up no evidence in its suit to show that it granted to Berliner another's property save, by inference, its own in the Bell transmitter, was there in fact any property of others besides Bell granted to Berliner by the Government?

To me it seems that there was.

If we examine the Berliner files we learn that he filed, on April 14, 1877, a caveat for a constant-contact microphone. On June 4, 1877, his application for a patent was filed for a make-and-break transmitter, and not until 1880 was the attempt made to make this application include the constant-contact principle disclosed in the caveat.

To include in this application the constant-contact principle was a matter of such moment to the Bell Company's attorneys that they were compelled to amend the application by striking out the whole specification and claims except the title and signatures, and to file a substitute for the same, which was a perfectly proper procedure and within their rights provided the substitute remained within the matter of the original application.

The attorney recognized that the contact principle was not only within the matter of the original application, but that it was diametrically opposite. To introduce this new opposing matter required considerable ingenuity, but the attorneys were equal to the occasion and filed the amendment containing the constant-contact claim.

On the constant-contact principle being objected to as new matter the attorneys astutely claimed that the amendment did not contain new matter since it was the matter of the caveat and they claimed the right to amend the application by the caveat on the ground that the application was a continuation of the caveat.

The Patent Office examiner held that the application was not a continuation of the caveat.

To make a long story short, the attorneys took an interlocutory appeal to the Commissioner of Patents in person.

Such an appeal was to ask the commissoner to order the examiner to admit the matter as presented.

This was the result of the appeal. The commissioner *did not order the matter to be admitted as presented for constant contact between electrodes, but did order it to be admitted for a diaphragm and electrodes in contact.* But the examiner went beyond the order and admitted it as issued for electrodes in constant contact.

In this irregular proceeding of going beyond the warrant of the decision of the appeal and in the irregular proceeding of amending the application by caveat, resides the fact that Berliner was granted on the part of the Government the property rights of others.

If Berliner wished to keep up his right to constant contact between electrodes as disclosed in his caveat, he should have renewed his caveat or else have filed an application for letters-patent for the same matter. But having let his caveat lapse, and never having filed an application for letters-patent for electrodes in constant contact, it became too late, in view of the state of the art in 1880, to then make such application. It was for this reason that the interim between the caveat and 1880 was bridged by amending in 1880 the application for letters-patent filed June 4, 1877, by the caveat of April 14, 1877.

Such an amendment should not have been allowed, no matter how many supplementary oaths Berliner might take as to the time of his invention of electrodes in constant contact; for it is not permissible by oath, much less by caveat, to introduce new matter into an application.

No doubt the commissioner recognized that Berliner had no right to introduce new matter by oath or by caveat when he confined his decision to contact between diaphragms and electrodes.

Since the operation of the caveat the constant-contact principle has been embodied in many inventions that have lived and expired as patents, and since one patent issued to Edison particularly specifying and claiming constant contact between electrodes was filed several weeks before Berliner filed his application for letters-patent therefore the property of the Berliner caveat resides in the people of the United States, and perhaps they do have the right to recover the same if the above position is sound. But this evidence has not been presented by the Government in its suit, probably because knowledge of the same could not be obtained because the Edison patent was not issued until 1892, some time after the institution of the suit.

If the Supreme Court shall hold that the Government has the right to bring suit, then the second and third counts of the case will have consideration.

The second count alleging fraud on the part of the Bell Company in its procedures in the prosecution of the Berliner application, I shall pass over, since I believe that the Bell Company kept within the letter of the law if not within its spirit.

The third count set up by the Government in its case, as to the identity of the 1880 and 1891 patents to Berliner, involves two considerations.

First: If they are identical, has the Government power to bring suit to recover? The preceding discussion of this matter is here applicable. The 1880 patent having expired, however, the property in the same resides now in the public, and perhaps it has the right through its Government to bring suit.

Second: The defence of the Bell Company that the transmitter shown in the 1880 patent is but typical of any transmitter, and therefore but illustrative, is fallacious, because this was matter of the caveat of April 14, 1887, when no other transmitter, save the Bell, was known.

All questions as to molecular theories, *et cetera*, are beside the question except so far as they may serve to couple the Bell and Berliner inventions. But whatever the theory of their actions, there can be no difference in their actions *per se;* for by decision of the Supreme Court in the Bell case, all electrical speech transmission is by one certain method only (*sic*).

It is not my intent to question Berliner's masterly work, not to take from him the credit for what he has done. I merely question the procedure of his attorneys in the prosecution of the 1891 patent and strive to bring into definite order and prominence the counts involved in the Government suit.

Should the Government be defeated, then there would be no sense in again attacking the Bell Company. But if the Bell Company should bring suit against any defendant for infringement of the Berliner 1891 patent I think there is abundant evidence to successfully defeat their attack.

The particularly strong ground for defence under this circumstance is the evidence I have before brought to notice through the columns of The Electrical World and again emphasized here.

I think there need be but little uneasiness over the situation in case the Government fails in its suit; for the Bell Company, while thoroughly alive to its legal strength, is also keenly aware of its inherent weakness.

Electric Motive Power on the New Haven Road.

President Charles P. Clark, of the New York, New Haven & Hartford Railroad Company, appeared before the Railroad Committee of the Connecticut Legislature at Hartford on Feb. 16, and explained what his company has done and what it proposes to do in the way of using electric motive power, especially between New Britain and Hartford. This information, it should be explained, was desired in connection with the hearing on a petition for a franchise for a new road between these two points, which road would parallel the line of the New Haven Company. Mr. Clark argued against the granting of the franchise, and regarded an additional investment of capital to accomplish the purpose as unnecessary and unwise.

Mr. Clark gave some interesting facts of a historical nature concerning the electrical experiments on the Nantasket Beach branch of his company's lines. He described the main features of the overhead construction and the character of the business of the line. At the close of the first season he obtained figures which showed that with business in volume electricity proved a much cheaper source of conveying power generated in a stationary plant than to generate the same power at the head of the train. He found also that notwithstanding the entire absence of insulation, either on the feeder or trolley wires, save only the wooden posts on which they were carried without an ounce of glass or porcelain, the leakage of current was very much less than had been experienced by any street road with whose figures he had become familiar.

Mr. Clark then told how the electric system was tested to determine its availability for heavy work. The company found that over one thousand tons, dead weight, could be hauled in either direction, and thus demonstrated that electric power was no longer a plaything, but would answer for serious work.

The extension of the Nantasket Beach line towards Boston next received Mr. Clark's attention. The difficulties presented to the extension of the overhead trolley system were many and formidable, and to carry out the work on this system would involve a large amount of reconstruction work on the road-bed itself and at great expense—which was practically prohibitive. In view of these facts, the question of a centre or third rail was considered. Trouble then began, continued the speaker. The electricians all told us that the current would be lost and that we might put as much current as we pleased at one end, and at the first five miles it would be dissipated. They were asked to suggest a remedy for that, and they handed in what Mr. Clark stated to be "an involved set of figures" such as he had not seen since he left school. They calculated that so many copper feeders would be necessary. A one-hundred pound rail was laid. The electrical engineers proposed a "number of elaborate schemes for insulating the rail. These suggestions, however, were all cast aside because Mr. Clark thought that simple blocks of wood would answer the purpose just as well, and the blocks of wood were tried." "I give you my word," continued Mr. Clark, "that ever since that day the electrical talent of this country has been trying to invent some excuse for the current keeping on those rails and doing its work. Their tests, showing practically no loss, amazed them, and they confessed that they could not understand it. They predicted that trouble would come with rain, snow and ice. A cloudburst came soon after, and all three rails were under water for several hours, but the cars went on just the same."

Referring to the proposed electric line between Hartford and New Britain he stated that the problem was not simply one involving these points, but a living one all through the country. "The New Haven road," he said, "has no quarrel with electricity; on the contrary, electricity has harnessed itself in its service, and is more highly appreciated by the New Haven road to-day than by the managers of any other steam railroad in the country. Our locomotives may go into the scrap heap, as the old stage coaches had to go. We must keep up with the times, or we shall be left in the rear."

The Two Great Science Associations.

BY WILLIAM H. HALE.

It is none too early to arouse the interest of electricians in the approaching meetings of the two great associations for the advancement of science, which are to be held next August. The American Association will meet at Detroit, on Aug. 9, and will adjourn to Toronto to welcome the British Association which will meet there on the 18th.

This is the second visit of the British Association to America, the first having been made in 1884, when they met at Montreal. Those who, like the writer, were present on that occasion, can make some forecast of the elaborate preparations now under way for the Toronto meeting. The sum of $27,500 has been appropriated to defray expenses. A round of receptions and excursions has been arranged, including two conversaziones, and many other social functions. The excursions cover nearly all the Dominion. Rates have been given across the Continent for half-fare, and as far as the nickel mines at Sudbury at about one-quarter fare, besides many shorter excursions, including a trip to the gold mines of Western Ontario, and a visit to the delightful Muskoka Lake on Saturday, Aug. 21, with a stop-over till Monday, a delightful rest in the midst of the hard work of the meeting, as many of us know who made the same tour at the Toronto meeting of the American Association a few years ago. The long excursions which follow the meeting may be supplemented by free trips over numerous branch roads of the Canadian Pacific Railroad.

The meetings of the Association will be held at the University of Toronto and the School of Practical Science, situated close by it, and in the residential portion of the city. The evening lectures will be given in the new Massey Hall, which seats 4000 people.

This meeting, interesting to all, must be especially so to electricians, for Lord Kelvin and W. H. Preece have announced their intention to be present. All branches of science will be well represented. A delegation of forty or fifty is expected from the Continent. The retiring president of the Association is Lord Lester; the president-elect Sir John Evans.

This meeting should be preceded by a rousing gathering of American scientists in our own Association, which appeals strongly to all loyal American scientists for support. Our meeting in 1884 when the British members united with us at Philadelphia, after the close of their own meeting, was the largest in our history, numbering nearly 1300. This year we do not expect so many from abroad, because comparatively few will reach this country in time for it. This gives all the more reason, however, why we should attend in large numbers ourselves.

Members of our Association will be admitted to membership in the British Association on the same terms as their own members, namely, on payment of $5 dues, instead of $10, which other new members must pay.

The army of young electricians which has grown up within the last decade have not had their attention called to the A. A. A. S., or have not stopped to consider the claim it has on them as scientists. An association which included among its founders Joseph Henry, and which now has as fellows: Edison, Tesla, Elihu Thomson, J. W. Gibbs, Arthur W. Wright, A. M. Mayer, O. N. Rood, H. A. Rowland, A. A. Michelson, William A. Rogers, etc., should gather in electricians *en masse;* and it is to be hoped that the Detroit meeting will witness just such a consummation.

Electricity on the Manhattan Elevated Railways.

The discussion of electric propulsion for the New York elevated railways, which has been carried on for more than eleven years, seems to have reached its end. There is every reasonable prospect that the Manhattan Railway, realizing the loss of passengers entailed by its adherence to the steam locomotive, with its attendant nuisances, and doubtless somewhat influenced by popular opinion, is about to equip its lines with an electric system. The conservatism of the management which, after experimenting several times with electricity in past years, continued the unsatisfactory but reliable steam service, is to be commended, since more than an experiment is required to prove the feasibility of a new motive power for so extensive a system and under such difficult conditions. Now that electricity has been so successful in its applications to other roads under nearly the same conditions of service, there is no longer occasion for the continuance of a method of operation that is not only a public nuisance, but which also entails a loss of revenue.

The company recently commissioned a board of engineers to examine and report upon the electric elevated system in Chicago, with reference to its feasibility for adoption in this city. The report was highly favorable, and was followed by another from Mr. William J. Fransioli, general manager of the Manhattan Company, who went personally to Chicago, and upon his return urged the adoption of electric traction. The two are now before the directors of the company, and although no definite statements have yet been given out, there is practically no doubt that the equipment will be authorized.

The first agitation of the question of electric propulsion for these railways was in 1885. On December 10 of that year Mr. F. J. Sprague read before the Boston Society of Arts a paper on the application of electricity to the Manhattan system. The ideas advanced, at a time when the now familiar electric street railway was still in a crudely experimental state, created the greatest interest, and found practical expression in the latter part of 1886, when a car was operated by Mr. Sprague on the Thirty-fourth Street branch of the elevated railway. This historic experiment demonstrated the possibility and feasibility of electric traction on a large scale, but clearly showed that the art was not sufficiently advanced to permit the retirement of the objectionable yet reliable steam locomotive. The methods employed by Mr. Sprague, single-reduction gearing, axle suspension for the motors, and the equipment of the trucks of the passenger cars rather than the use of an independent locomotive motor, accurately foreshadowed the most modern practice, and showed that even at that early day the principles of electric traction were well understood.

The next attempt to substitute electricity for steam was in the early part of 1889, the Ninth Avenue line being the theatre of operations. The motor, designed by Leo Daft, was of the locomotive type, consisting of a large four-wheeled truck, upon which was mounted a bi-polar motor. This machine was kept in active service for some months, hauling a train of four cars in regular schedule with the steam trains. Its defects were numerous and evident, but it again demonstrated the ample sufficiency of electric power for the purpose, and went far toward removing the feeling of uncertainty attending its operation.

The enormous cost of equipping the road, the mechanical and electrical weaknesses of the motors and dynamos of that day, the uncertain data from the few experiments made, and the absence of that experience which alone could guarantee the continuously successful operation of so large a system, all militated against the use of electricity. The experiments had demonstrated that the time was not yet ripe for the change, but had conclusively shown that electric traction would, sooner or later, be the inevitable solution of the problems which the operations of the roads entailed. For more than six years no further attempts were made to replace the steam locomotives, and the citizens of New York bore with them as a necessary evil, being sustained by a distant hope of what the future might bring forth.

Meanwhile the electric street railway was affording an unexampled opportunity for the development of the motor and the dynamo, and the solution of the difficulties of line insulation and distribution. The demands of suburban and interurban service had resulted in the design of powerful and reliable motors for high-speed service under the most difficult conditions.

At the Chicago Exposition of 1893 the intramural elevated railway was most successfully operated by electricity under conditions not materially different from those on the New York elevated railways. In Liverpool a successful system had been inaugurated in March of that year, and the closing of the exposition was followed by the equipment of the West Side Elevated System, in Chicago, with electricity throughout.

The last experiments upon the elevated system in New York were conducted by the Electric Storage Battery Company during the latter part of last year. The locomotive, designed by Mr. J. B. Entz, carried a storage battery of considerable size, and also received currents from a third-rail conductor. Excellent results were attained, the Thirty-fourth Street branch line being the scene of operations.

The problem of successfully equipping the elevated systems with electricity seems to present no special difficulties, save those involved by the magnitude of the installation. The present equipment consists of 1117 cars, operated by 331 locomotives, on about 71 miles of double-track structure. The New York *Sun* of February 17 publishes the following interview with General Manager Fransioli:

"'I have just returned from Chicago, where I devoted several days to investigating the system in use there, which is essentially the same as that which is working so well at the Brooklyn Bridge terminals. The Chicago elevated roads using this system run four-car trains with a 1½-minute headway, which is one-half the headway allowed on Third Avenue, at a slightly greater speed than that at which the Manhattan trains run, and stopping at stations about the same distance apart as here in perfect safety, and at an operating expense considerably less than that of the Manhattan Company. The motor cars are, as in the bridge system, also passenger coaches; a motor is placed on each truck and the operator stands at the controller, which is in a little cab-like compartment built on the car platform. In use here this arrangement would be modified by placing the motorman just inside the car, at the end, the controller and other apparatus occupying about the space of three seats. Air for brakes is compressed by a pump operated by another small motor, also under the car.

"'I am not yet acquainted with the details of any practical trial the directors may decide to give this system here, nor do I know of any contracts or other arrangements contemplated. The General Electric Company are makers of the plants I have been investigating, and they have been figuring on the trial on Thirty-fourth Street, but I don't know that we would get our plant from them. We own several available sites for power stations, notably one on the East Side at One Hundred and Twenty-ninth Street, and one on the West Side at One Hundred and Fifty-fifth Street."

President Russell Sage, referring to the matter, said:

"The report of our manager was so favorable that, coming from him, in whom we repose the greatest confidence, it was almost decisive. The electrical system will be tried on the Second Avenue line, where there is the least travel, and if successful will be extended. Operators will learn to handle the trains on Second Avenue, and as the system is extended they will be put on the other lines, and others will learn the ropes on Second Avenue. One motor car will draw itself and three other cars, or a train of eight cars may be run with two motor cars."

Messrs. Houston & Kennelly, of Philadelphia, have sent THE ELECTRICAL WORLD the following communication on this subject:

"The proposition to operate the elevated railroads of New York City electrically instead of by steam, as at present, offers manifest advantages to the public in the direction of speed and convenience.

"The great reliability of the electric motor as a driver of a car or train or cars, the simplicity of its parts and the readiness of its control enable slightly greater speeds to be attained even on the short runs that the elevated railroads are obliged to employ under the present system of steam traction.

"It would be possible to operate single, double or triple cars, each provided with its own motors and each car or train operating independently, like cable cars, upon a headway of not more than ¾ of a minute, and yet operate the system with perfect security by the introduction of automatic methods of electrical control, whereby two cars or trains could not both be propelled coincidently upon the same section.

"The absence of coal dust and cinders, with the attendant consequences of coolness and cleanliness in hot weather, and the rapid succession of these cars, would make the system eminently popular with the public. At the present time passengers travel by the elevated road because they have to; with electric traction they would not only have to, but they would be glad to.

"As regards economy in operation, it might be expected that electric traction would show some economy over steam traction, but the main advantage to be gained by the Manhattan Company would be in the greater popularity of the service, together with a reduced

rather than an increased expenditure per car mile of passenger traffic.

"As to the particular electrical system to be preferred, that would necessarily be a question of importance in detail. Almost any reasonably planned and properly constructed system would give satisfaction to the public. Only the most economical system would give satisfaction to the company."

Professor Galileo Ferraris.

BY HENRY S. CARHART.

The death of this distinguished Italian physicist comes as a personal loss to many electricians who were in attendance at the International Electrical Congress in Chicago, in 1893. He was the sole representative of Italy in the Chamber of Delegates. A little incident that occurred at the last session but one of that body illustrates the quickness and clearness of his intellect. A committee, representing some of the most distinguished members of the Chamber from different nations, had been appointed to formulate the definition of the unit of inductance—the henry. This committee had met and had failed to write a definition which was satisfactory to any one. Two forms were reported, and after a few minutes' discussion, Professor Ferraris suggested a change in one of them, of not more than two or three words, which put the definition in the final form in which it now stands. It was at once apparent that this man, who spoke English with much difficulty and hesitation, had formulated in a foreign tongue a definition which his English-speaking confreres had essayed to do in vain.

It was the good fortune of the writer to meet him frequently

Galileo Ferraris

during the Congress, and afterward in the electrical building at the Fair. He was genial, alert, interested, and spoke charmingly of his own work when asked about it. It was highly probable to one acquainted with the theory of elliptically and circularly polarized light that he had arrived at the conception of the rotating magnetic field from that theory as a suggestion. On inquiry, this was found to be true. The idea came to him while walking along the street, he said, and in a couple of days he had tested it with success. This was in 1884 or 1885. He spoke without feeling, but with a distinct tinge of melancholy to his words, of the pitifully small return which he received for his brilliant conception. It was a case where a man with ideas in advance of his time had failed to see the commercial possibilities in a method which his brilliant brain had given to the world. It is true that before this Walter Bailey, of London, had exhibited the connecting link between Arago's rotations and the true rotating field, and Marcel Deprez had formulated the ideal theorem for the theoretical production of a rotating magnetic field; but up to this point no one had succeeded in actually producing such rotations. Ferraris embodied the conception in working models, and a little later (1888) described them with admirable clearness, which left nothing to be desired.

Ferraris had made himself a citizen of the world. Italy is the chief mourner of this brilliant man and warm, genial personality, but the civilized world claims the right to lay on his bier a token of affection and to drop a tear at his tomb.

The Copper Supply.

The slight increase in the stocks of copper on hand, which was shown near the end of last year has disappeared, and the visible supplies show a decrease instead. According to the *Engineering and Mining Journal*, this indicates no diminution in the European demand for the metal, which continues extraordinarily active. There are signs of a growing demand in this country also as business revives, and there is, for the present, not much chance for an oversupply. The uncertain factor is how much longer the consumption in Europe will keep up at the present high level. The demand for electrical work is increasing rather than diminishing. In France and Germany, and even in England, the electric street railroad is just beginning to take hold, and a large amount of work of that kind is promised; in fact, it will take two or three years at least to carry out all the projects now started. In other kinds of electric work there is also great activity. For the manufacture of war material a demand will be maintained as long as the nations of Europe keep up their armies on the present footing. These, too, have been the chief causes of the great demand for copper, and they seem likely to continue active for some time yet. The demand for copper from India has been only moderate. This is chiefly supplied from London, and Eastern supplies being taken from stocks there rather than from producers. It might be well to inquire whether this trade might not be supplied directly, to our own advantage.

To Do Its Own Lighting.

A Baltimore paper is authority for the statement that the receivers of the Baltimore & Ohio Railroad Company are establishing independent electric-lighting plants at all important points along the railway system. A complete plant was put into service quite recently at Zanesville, O., and contracts have been closed for a complete electric-lighting installation at Philadelphia. The latter plant will be located at Twenty-fourth and Chestnut Streets Station, and will furnish lights for the Race Street yards, coal piers, round house and the principal passenger station. Wires will be carried overhead alongside the Company's tracks to the Jackson Street piers, which are located seven miles away, and the lighting of these piers will be thus provided for. With the completion of this plant it is stated that the Baltimore & Ohio Company will then own thirteen plants having a total capacity of about 1500 arc lights and 9000 incandescent lights. The receivers of the road, it is stated, are establishing these plants with the belief that a great saving can be effected and better results obtained by absolute ownership and control by the Company itself. Electric power has displaced steam power at the general freight sheds at Locust Point, for operating the freight elevators.

Chemical Meters Displaced by Mechanical Meters.

The Edison Electric Illuminating Company of New York City is installing in a large number of new service connections, and also substituting for many of the old chemical meters the Thomson mechanical wattmeters. As is well known, this meter is practically a small motor, whose armature is connected across the line and field coil in series therewith. Mr. Lieb, the general manager of the company, stated that the principal reason for this change is the fact that many of the customers of the company prefer a meter in which they can see the wheels go round. It would also appear that a decreased cost of operating the meter department would result. We are informed that about 300 of these meters have been installed throughout the city.

Alternating Current Machinery.—V.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER V.

EFFECTIVE E. M. FS.

45. If a sinusoidal E. M. F. could be permitted to act upon a circuit containing resistance only, there would be produced in the circuit a sinusoidal current whose strength would be determined from moment to moment by Ohm's law. For example, suppose that an alternating-current generator produces a sinusoidal E. M. F. having a frequency of 100~ and an amplitude of 200 volts, and that this E. M. F. is automatically maintained at its terminals under all normal loads. The E. M. F. is expressed by the relation $e = E \sin \omega t$, where E is the maximum E. M. F. in each cycle, or the amplitude of the sinusoidal E. M. F., ω is the angular velocity of the equivalent rotation corresponding to the frequency of 100~; namely, an angular velocity of $100 \times 2\pi$ radians per second, or 200π radians per second; and t, is the time in seconds from some moment at which the E. M. F. is zero and rising in the positive direction. Then $e = 200 \sin (200\pi t)$ volts.

46. Suppose that the external circuit provided for this machine is formed of a German-silver double-wound resistance coil, having a resistance of 40 ohms. If this coil were connected to a continuous E. M. F. of 200 volts, the current strength which would pass though it would be continuous, and would have the value $I = E/R = 200/40 = 5$ amperes by Ohm's law.

If the coil be connected to the terminals of the alternator, the current strength which will flow through it will be $i = E/R \times \sin \omega t$, $= 200/40 \sin. (\pi\, 200\, \pi\, t) = 5 \sin (200\, \pi\, t)$ amperes. The current wave is, therefore, a sinusoid, having the amplitude of 5 amperes, *i. e.*, reversing between + 5 amperes and — 5 amperes, with a frequency of 100 ~ or an angular velocity of 200 π radians per second. This current wave is exactly in step with the E. M. F., because, by the above equation, when t, is any exact number of seconds, say a single second, or 1, $200\, \pi\, t = 200\, \pi$, which is an even number of complete revolutions, or $100 \times 2\pi$ so that sin $(200\, \pi\, t)$ = sin o = zero, and the E. M. F. is therefore zero. The current, therefore, has zero value at the moment when the E. M. F. at the terminals is zero, and in the same way, it is easy to see that the current is a maximum when the E. M. F. is a maximum.

47. The relation between the above sinusoidal E. M. F. and its

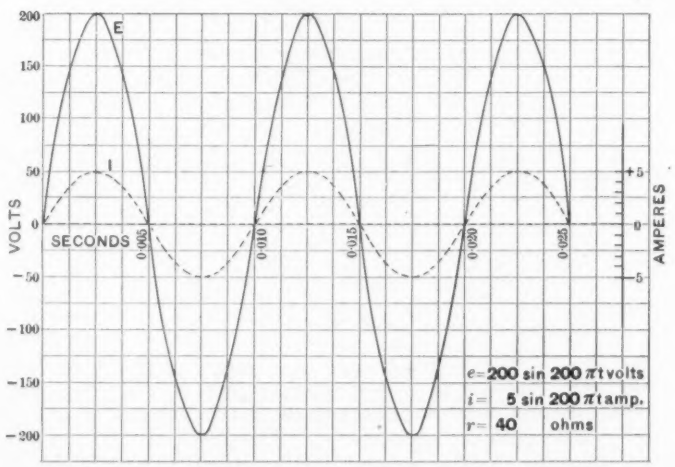


FIG. 24.—SINUSOIDAL E. M. F. AND CURRENT IN A NON-INDUCTIVE CIRCUIT.

current is represented in Fig. 24, where the E. M. F. is drawn to the left-hand scale, and the current strength is drawn to the right-hand scale.

48. Similarly, the current strength through a double-wound resistance coil of 400 ohms resistance would be sinusoidal, with an amplitude of 0.5 ampere. The above relation between the current strength and the E. M. F. is only true on the assumption that the double-wound resistance coil produces no sensible magnetic field. In point of fact, this supposition is not strictly true, although it is so nearly true in the case of a double-wound resistance coil that it may be accepted for all practical purposes. In the ordinary commercial alternating-current circuit the current which flows through the circuit produces a very appreciable magnetic flux, which, not being stationary, but periodically waxing and waning with the current, produces a reaction upon the circuit developing a counter E. M. F., which in turn reduces and modifies the current. This property of a circuit is in fact usefully exaggerated in such alternating magnetic apparatus as alternating-current transformers, and is called the *self-inductance* of a circuit. A circuit with negligible self-inductance not only permits a sinusoidal E. M. F. to establish a sinusoidal current in the circuit, but also permits any variety of periodically alternating E. M. F. to establish its corresponding prototype of current, so that the graphical wave of E. M. F., no matter how complex in outline, would still be the graphical wave of current to some suitably proportioned scale. Such a circuit is, approximately, realized in an ordinary incandescent lamp, which has an approximately negligible magnetic field, and is therefore *inductanceless*. It is also approximately realized in double-wound resistance coils, as already mentioned.

49. A circuit with appreciable self-inductance so modifies the current that only a sinusoidal E. M. F. will establish its prototype; *i. e.*, a sinusoidal current. Any other E. M. F. will establish in the circuit a current whose graphical delineation differs to a greater or less degree from the graphical delineation of the impressed E. M. F. For the present, therefore, we shall confine our attention to the ideal sinusoidal types of E. M. F. and current.

In the case of a continuous current, the strength in amperes is obviously the constant number of amperes flowing through the circuit. There can, therefore, be no doubt as to the value of the current strength. In an alternating-current circuit, however, the strength varies periodically from a maximum positive to a maximum negative quantity, so that there are two maxima and two minima in each cycle. Consequently, the question properly arises as to what shall constitute the *nominal strength* of an alternating current. It might be defined as the maximum, which in the case of a sinusoidal current would be its amplitude, or it might be defined as the arithmetical mean value without regard to sign, that is to say, the arithmetical mean value taken over a single pulse or alternation. In either of the above cases, however, the difficulty would exist that although the strength of current would be perfectly defined for strictly sinusoidal currents, yet since, in practice, alternating currents are often far from being sinusoidal, the effects produced by an alternating current would depend not only upon its nominal strength, but also upon its wave type. For this reason, a

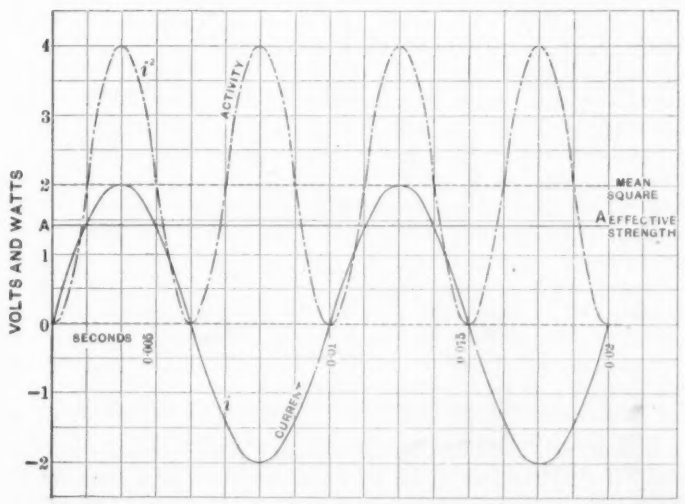


FIG. 25.—EFFECTIVE STRENGTH OF A SINUSOIDAL CURRENT.

measure is adopted which is applicable without restriction to all types of currents whether sinusoidal or not, and indeed whether alternating or continuous. The measure, invariably adopted for the strength of an alternating electric current is called the *effective current strength*, and may be regarded as the thermally effective current strength, since it practically represents the thermal activity of the current in traversing a given resistance.

50. With the continuous current of strength i amperes, we know that its activity when traversing a resistance of r ohms is $p = i^2 r$ watts. This activity p, is developed as heat, or is thermal activity. If r, be chosen as exactly one ohm, $p = i^2$ watts. In the same manner, the activity at any instant of a sinusoidal alternating current, traversing one ohm, will be $p = i^2$ watts. but i, in this case, is no longer steady, but follows the law $i = I \sin \omega t$. $\therefore p = i^2 = I^2 \sin^2 \omega t$. The thermal activity of a sinusoidal current, therefore,

fluctuates between a maximum value I^2 and zero. The graphical representation of the activity of the sinusoidal current, having an amplitude of 2 amperes and a period of 0.01 second, is represented in Fig. 25. The continuous line is the graph of the current i, while the broken line is the graph of its square or i^2. It will be seen that the activity does not change sign, that is to say, the activity is evidently always absorbed by the one-ohm coil. In other words the coil cannot act as a generator at any time. If the average thermal activity be determined either geometrically, or by some physical process, this average may be called the *effective thermal activity* of the current, and is represented in Fig. 25, by the horizontal dotted line of 2 amperes. The strength of continuous current, which, if constant, would produce this average thermal activity would be represented by the full line AA, and is represented as being 1.414 amperes.

51. The process here represented geometrically may be performed at once algebraically as follows:

The instantaneous activity is $i^2 \quad I^2 \sin^2 \omega t$, and the total amount of work done during one cycle is the integral of this quantity with respect to time taken from $t = O$, to $t = T$, or one complete period. The average activity will be this total quantity of work divided by the time or

$$\text{Mean } i^2 = \frac{\text{Total work}}{T}.$$

This gives the mean square of the current and the effective current strength is the square root of this quantity or

$$\sqrt{\text{mean } i^2} = i = \sqrt{\frac{\text{Total work}}{T}}$$

The effective value is, therefore, the square root of the mean square of all the values during one cycle.

52. A similar line of reasoning applies to the determination of the E. M. F. in an alternating-current circuit. The effective value is always selected, and this may be regarded as the *thermally effective value*. If a continuous E. M. F., e, be connected to a constant inductionless resistance r, the current strength by Ohm's law will be e/r, and the activity e^2/r. If r be chosen as unity the activity is e^2. When the E. M. F. is alternating the activity at any instant is e^2 $(E \sin \omega t)^2 = E^2 \sin^2 \omega t$. The mean activity during any one cycle will be the total amount of work expended by the E. M. F. during one cycle or the integral of $E^2 \sin^2 \omega t$, with respect to time between $t = o$, and $t = T$; consequently,

$$\text{Mean } e^2 = \frac{\text{Total work}}{T}$$

The effective E. M. F. will be the square root of this mean square of $e = \sqrt{\frac{\text{Total work}}{T}}$, consequently the same rules apply to the determination of the effective values for both alternating E. M. F. and current.

53. In Fig. 25 the maximum current or current amplitude is 2 amperes, while the effective strength is $\sqrt{2} = 1.414$ amperes. Consequently, for the sinusoidal wave of either E. M. F. or current, the ratio of maximum to the effective value is $\sqrt{2}$. Thus, if an alternator produces a sinusoidal E. M. F. and maintains an effective pressure of 100 volts at its terminals, an incandescent lamp which gives, say, 16 candles when connected to 100 volts of continuous E. M. F., will also give 16 candles when connected directly to the terminals of the alternator, since the thermally effective E. M. F. is the same in each case. Moreover, the maximum E. M. F. at the terminals of the alternator will be $100\ \sqrt{2} = 141.4$ volts, and the lamp will, therefore, be subjected to sinusoidal variations of pressure having an amplitude of 141.4 volts, or a total range from + 141.4 volts to—141.4 volts. The ratio of $\sqrt{2}$ between maximum effective values is only found in the case of sinusoidal waves. With other types of wave the ratio is either greater or less.

54. The above and other ratios for several simple types of waves are given in the accompanying table. It will be seen that the ratio E/e varies from 1.0 in the case of strictly rectangular waves to 3.23 in the case of very sharp pointed waves formed of inverted quarter ellipses or quarter circles. In the first column of this table is given the wave type, in the second the graph of that wave, in the third the ratio of the maximum square to the mean square, in the fourth the square root of this quantity or the ratio of the maximum to the effective E. M. F., while in the fifth column is the ratio of the maximum E. M. F. to the arithmetical mean E. M. F.

55. Another means of geometrically determining the effective E. M. F. or current of a given type of wave is represented in Fig. 26. In this figure a sinusoidal wave is plotted to polar co-ordinates instead of to rectangular co-ordinates. Thus from O, as centre, radii such as OA, $O = 30°$, $O = 60°$, are laid off at suitable angular distances and along these radii are marked off the values of the E. M. F. or current at these phases (P. 12). Thus in the figure, a sinusoidal E. M. F. is represented. At OA, or O, the sine is o, at O 30° the sine of 30°=0.5, is laid off as the distance OS, which is half OA. At 60° the sine of 60°=0.866, is laid off, as the distance OS=0.866. At 90° or $\pi/2$ the sine 90°=1, is laid off as OB. This process is continued round the circle with a sufficient number of radial points and distances until the entire curve, $OS^1S^2BS^3S^4$ $OS_1S_2DS_3S^4$ is laid off. It will be seen that the curis a pair of circles, having their centres upon the line BD, midway between the centre O, and the circumference and having equal radii, each half the radius OA. If this curve be marked off and the area $OS^1S^2BS_3S_4$, plus its equal $OS_1S_2DS_3S_4$, be measured and the circle *abcd* is drawn so that its area shall equal this total area, then the length of the radius Oa, is equal to the effective value of the E. M. F. or current so plotted, since the area of $OS^1S^2BS^3S^4$, is a circle of half the diameter of CA, its area will be one-quarter of the area of the main circle $ABCD$. Consequently the sum of the areas $OS^1S^2BS^3S^4$ and $OS_1S_2DS_3S_4$, will be half the area of $ABCD$. The circle *abcd*, must, therefore, be constructed so as to have half the area of $ABCD$, and when this is done we know that the radius OA, is $\sqrt{2} \times$ radius Oa, which is the fundamental relation between the maximum and the effective value for a sinusoidal wave.

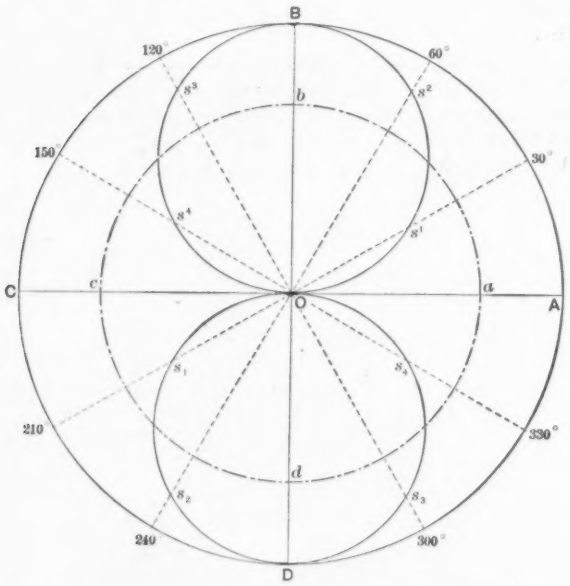


FIG. 26.—POLAR DIAGRAM OF SINUSOIDAL E. M. F.

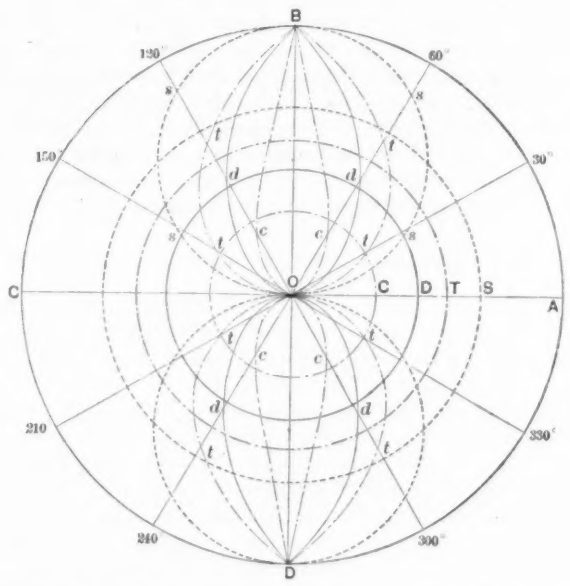
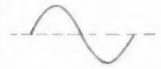
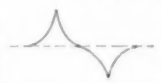
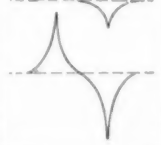


FIG. 27.—POLAR DIAGRAM SHOWING COMPARISON OF EFFECTIVE VALUES FOR RECTANGULAR, SINUSOIDAL, TRIANGULAR, INVERTED-SINUSOIDAL, AND INVERTED-CIRCULAR WAVE-TYPES.

56. In Fig. 27, the rectangular, sinusoidal, triangular, inverted sinusoid and inverted circular wave types are plotted to polar co-ordinates on the same sheet for readiness of comparison.. Thus the complete circle *ABCD* is the polar graph of the rectangular wave, the pair of circles *SSS* is the graph of the sinusoidal wave, *ttt* is the graph of the triangular wave, *ddd* the graph of an inverted sinusoid, and *ccc* the graph of an inverted circle or eclipse. All the waves having the same maximum value, the corresponding circles which have the same area as the total area enclosed by the graphs have radii *OA*, *OS*, *OT*, *OD* and *OC*, respectively. These have the ratios $1\ \frac{1}{\sqrt{2}},\ \frac{1}{\sqrt{3}},\ \frac{1}{2.1}$ and $\frac{1}{3.23}$.

57. From these figures it will be evident that the ratio of maximum to effective E. M. F. is least for a flat type of wave, and greatest for a sharply peaked type of wave. In the sinusoid its standard value is $\sqrt{2}$=1.414. In commercial practice the ratio is usually between 1.2 and 1.6. Thus the ratio of maximum to effective E. M. F.

TABLE OF RATIOS BETWEEN MAXIMUM, EFFECTIVE, AND MEAN VALUE FOR A FEW SIMPLE WAVE FORMS.

Wave Type	Graph.	Ratio of $\frac{E^2}{e^2}$ Maximum Square / Mean Sq.	Ratio of $\frac{E}{e}$ Maximum / Effective	Ratio of $\frac{E}{m}$ Maximum / Mean	Remarks
Rectangle		1.0	$\sqrt{1}=1.0$	1.0	E=Maximum numerical value in cycle.
Semi-Ellipse		1.5	$\sqrt{1.5}=1.225$	$\frac{4}{\pi}=1.273$	e=Effective value, or sq. root of mean cyclic value of square
Semi-circle		1.5	$\sqrt{1.5}=1.225$	$\frac{4}{\pi}=1.273$	
Semi-Ellipse		1.5	$\sqrt{1.5}=1.225$	$\frac{4}{\pi}=1.273$	m=Mean or average cyclic numerical value without regard to sign.
Sinusoid		2.0	$\sqrt{2}=1.414$	$\frac{\pi}{2}=1.571$	
Triangle		3.0	$\sqrt{3}=1.732$	2	
Inverted Quarter Sinusoid		$\frac{2\pi}{3\pi-8}=4.41$	2.10	$\frac{\pi}{\pi-2}=2.752$	
Inverted Quarter Ellipse		$\frac{6}{10-3\pi}=10.43$	3.23	$\frac{4}{4-\pi}=4.66$	
Inverted Quarter Circle		$\frac{6}{10-3\pi}=10\ 43$	3.23	$\frac{4}{4-\pi}=4.66$	
Inverted Quarter Ellipse		$\frac{6}{10-3\pi}=10.43$	3.23	$\frac{4}{4-\pi}=4.66$	

for an unloaded Niagara alternator of 5000 hp. is stated to be approximately 1.285.[1] Consequently in this machine an E. M. F. of 2000 volts at terminals represents a maximum cyclic E. M. F. at terminals of 2570 volts with no load.

58. The terms effective E. M. F. and effective current were adopted and defined at the Paris Electrical Congress of 1889; the effective E. M. F. being there defined as "the square root of the time average of the square of the E. M. F.," and the effective current being similarly defined. The terms virtual E. M. F. and virtual current are occasionally employed with the same significance. As already pointed out, the advantage of these rules is that an incandescent lamp gives the same candle power upon equal continuous and alternating voltages, so that virtually the effective E. M. F. of an alternating current circuit is the same as the E. M. F. of a continuous circuit when an incandescent lamp is brought to the same degree of incandescence; that is, has the same thermal activity when directly connected to each.

[1] *Cassier's Magazine*, July, 1895; page 298.

Twenty-fifth Anniversary Celebration of the Stevens Institute of Technology.

Stevens Institute of Technology, Hoboken, N. J., celebrated the first quarter of a century of her existence on February 18 and 19.

On the night of February 18 an elegant banquet was given at the Waldorf Hotel, New York, at which graduates and invited guests to the number of over 300 were present. The event was held in the new ballroom, which was resplendent with attractive and tasteful decorations.

Among the prominent persons present were Gov. Griggs, of New Jersey; Bishop Potter, Chancellor MacCracken, of the New York University; Chancellor McGill, of New Jersey; Andrew Carnegie, Abram S. Hewitt, Commodore Melville, U. S. N.; President Morton, of the Institute; Richard Stevens, E. P. Roberts, J. E. Watkins, Dr. C. F. Chandler, Col. E. A. Stevens and Charles McDonald. Mr. S. B. Dod, one of the trustees of the Institute, presided at the table of honor. About one-quarter of the number seated at the tables were ladies.

The first speaker was ex-Mayor Abram S. Hewitt, who responded to the toast, "Our Founder." Mr. Hewitt gave his reminiscences of the Stevens family, and stated that he was one of the few persons living who had personally known the elder John Stevens.

President Henry Morton read a poem on the work of the Stevens family, and then Mr. Andrew Carnegie responded to the toast, "The Ironmaster of the United States." His remarks were of a highly complimentary nature to the founder and graduates of the Institute.

Commodore George W. Melville, in response to the toast, "Our Ironclad Navy," referred to the difficult task experienced by John Stevens, Robert Fulton and other engineers in installing the marine engine, even as an auxiliary in ships of war. The triumph of the engineer over prejudice and tradition has been, he said, comparatively rapid, for it required but fifty years to make steam the principal motive power on board of warships.

Responses to other toasts were made, as follows: "American Citizenship," by Bishop Potter; "The Railroads and Steamboats of the United States," by Prof. Watkins, and "The Faculty," by President Henry Morton.

In the course of his remarks Prof. Watkins said that John Stevens, in 1792, took out a United States patent to propel boats by steam, and it was he who invented and constructed the first steamboat driven by a screw.

Just before President Morton was called upon to respond to the toast, "The Faculty," Mr. Dod announced the presentation to the Board of Trustees by Prof. Morton of 1000 shares of railroad stock toward the erection and maintenance of the proposed new Alumni building. This announcement was received with hearty applause. Prof. Morton, in replying to the toast, stated that the original faculty consisted of eight members; now it numbers twenty-two, the additions being, without exception, the intellectual children of the first eight. As for himself, he felt that his work, which had always been a pleasure, except on occasions when it was necessary to repress the exuberant spirits of undergraduates, was nearing its end, but he was solicitous that his successor should be duly equipped with the means to meet the more stringent demands of the future.

The most interesting feature probably of this celebration was the exhibition of various work done by the past graduates of the Institute. These various productions were distributed throughout the library, the physical laboratory, electrical laboratory, machine shop and dynamo room of the institution. Stevens' graduates, judging from this exhibition, have certainly directed their attention and given their labors to a most varied and universal field of scientific application. Engineering in all its branches was represented in these exhibits, of which there were nearly 100.

While many of the mechanical devices were of exceedingly great interest, some of them having attained prominence both in the scientific and commercial world, the electrical apparatus exhibited and the particularly prominent position it took in the general exhibit, is of special interest.

Prof. W. E. Geyer, professor of electrical engineering, and his assistant, Mr. A. F. Ganz, instructor in electrical engineering, had in addition to the exhibits of the graduates, prepared a number of exceedingly interesting arrangements of electrical devices, in order to illustrate some of the more prominent electrical phenomena. Among these, combinations of capacity and inductance arranged to show the peculiar mutual action of both, producing resonance, was most beautifully illustrated by working devices. Mr. Ganz also showed a recently devised experimental multiphase

motor. The usual apparatus used in the electrical course was also shown, and many of the arrangements for testing iron, measuring inductance, photometric appliances, galvanometers, etc., were shown in operation.

Mr. A. J. Wurts, a graduate of the class of 1884, who is now so prominently identified with the development of lightning arrestors and the discovery of non-arcing metals for this purpose, exhibited a very interesting display of his most recent productions in this direction. The exhibit was located in the physical laboratory, and consisted of two large boards, one of which contained an array of the latest forms of lightning arrestors, and the other was a most excellently arranged switchboard panel, showing the Wurts' circuit-breakers and switches. The switch contacts in the latter instruments were made up of a series of copper laminations, placed with their plane at right angles to the plane of the switch blade, and thereby producing an excellent and at the same time easy-making contact. The lightning arrestor board was presented by Mr. Wurts to the institute.

Mr. H. A. Wagner, a graduate of the class of 1887, and now connected with the Wagner Electric Manufacturing Company, of St. Louis, Mo., exhibited in the physical laboratory a very extensive collection of the productions of his company, including principally alternating-current apparatus. The well-known Wagner transformers, fuse cut-outs, switches and other devices, were shown and also a new single-phase alternating-current motor recently brought out by this company. This motor consists of a multipolar internally-directed ring field, the armature being wound with various sections of insulated conductors, whose terminals are brought to a commutator at one end. A switch, located at the commutator end of the machine, is operated in starting the machine, and by the operation of this switch the motor is first started with the armature and fields in series, the commutator being used as in any ordinary direct-current machine. A further movement of the switch handle throws a collector ring on to the commutator, entirely short-circuiting all of its segments and practically making the armature a closed coil. The connection with the field winding is broken at the same time, and the fields are left connected across the line. The motor then operates as a synchronous, single-phase induction motor.

A most interesting exhibit was made by Mr. J. F. Kelly, of the class of 1878, in the dynamo room. Mr. Kelly, as is well known, is now connected, and has been, since the beginning, with the Stanley Electric Manufacturing Company, and in conjunction with Messrs. Stanley & Chesney, developed the well-known S. K. C. alternating system. Many of the devices used in this system were exhibited. The latest type of inductor dynamo as used in this system was shown. This machine consists of fixed field and armature windings, with a rotating iron inductor, having polar projections on its surface, so arranged that the magnetic flux through the cores on which the field and armature windings are placed, is varied. A number of small two-phase motors and a collection of instruments used in this system were also exhibited. The recently developed static ground detector held a very prominent position amongst the latter.

The Bristol Company, Waterbury, Conn., with which Prof. W. H. Bristol and Mr. B. B. Bristol, of the class of 1893, are associated, exhibited a most interesting collection of their various recording and measuring instruments. These were shown in all varieties, including pressure recording gauges, temperature recording gauges, and voltmeters, ammeters and wattmeters. Most of these instruments were shown in operation, particularly the latter. The general construction of the Bristol electrical recording gauges is generally well known and hardly need any description here. Generally these instruments consist of a properly sectioned paper disc, rotated by a very excellent clock movement, and the record thereon is made by a pointer actuated by the indicating device. A peculiar feature of all these instruments is that iron is practically eliminated in all indicating devices.

The Prentiss Clock Company, of New York, exhibited in the Physical Laboratory various calendar clocks and a very ingenious automatic time switch. These devices were principally the work of Mr. H. S. Prentiss, of the class of 1884. The electric time switch, which is of particular interest, consisted of an ordinary knife blade switch, which is opened automatically by a small electro-magnet. The entire apparatus is mounted upon a neat marble base, and is intended to be used simply as a switch-opening device for turning off current at a certain pre-determined time. A clock with suitable contact devices closes the magnet circuit at a pre-determined point. The magnet trips a small latch, holding a spring-actuated arm, and the release of this arm and its sudden impact against the switch handle opens the latter. To reset the device, the switch is returned to its closed position by hand and the spring actuated arm placed so that it is held by the magnet actuated latch.

Probably one of the most interesting exhibits was the direct-connected 20-hp Nash gas engines and dynamo, displayed in the dynamo room by Mr. L. H. Nash, of the class of 1887, who is now connected with the National Meter Company, of New York City. This engine and dynamo combination were quite fully described in a recent issue of The Electrical World, and need no further description here. This generating unit is used for lighting the buildings after the steam has been shut down, and was presented to the permanent exhibition of the Institute.

The well-known edgewise Weston measuring instruments similar to those adopted in the Edison central stations in this city, which were devised by Mr. J. Van Vleck, of the class of 1884, were exhibited in the Physical Laboratory by him. Mr. Van Vleck also showed photographs and models of a triple expansion steam engine, known as the Van Vleck engine.

An Aylesworth & Jackson Röntgen-ray outfit was shown in operation in the Electrical Laboratory. This exhibit was made by Mr. F. E. Jackson, of the class of 1886.

A most interesting exhibit of incandescent lamps, both past and present, was shown in the Physical Laboratory by Mr. J. W. Howell, identified with the Edison Lamp Works, Harrison, N. J. This exhibit included two glass cases, one showing the various stages of the Edison lamp, from its first conception to the perfected lamp of to-day, and the other showing the numerous present production of the Edison Lamp Works.

Mr. W. P. King, of the class of 1886, associated with the New York Calcium Carbide Company, showed an experimental electric furnace in operation, and also a number of photographs and illustrations, showing his process of producing calcium carbide in the electric furnace. This process as illustrated in the small furnace is somewhat different from the arc process. The small experimental furnace which was operated at various times, consisted of two carbon blocks, between which was placed a small charcoal trough, the latter being in contact at each end with the sides of the blocks. The material to be heated was placed within the trough receptacle and the current was passed through the entire trough of charcoal from block to block, naturally heating it to intense incandescence. During the writer's presence, calcium carbide was produced in this furnace.

Mr. H. R. Smith, of the class of 1888, showed an illustrated description of a magnetic elevator.

A dynamo built by Mr. W. Strang, of the class of 1888, while a student, was shown in operation.

In the machine shop a most interesting exhibit of a wire-drawing machine was shown by Mr. W. D. Pearson. This machine is capable of drawing wire through ten sizes without being taken from the machine or handled in any way. The entire machine is exceedingly compact, and would hardly be credited with an output of this kind. Mr. Pearson is connected with the Waterbury Machine Company.

Drawings and photographs of electric power plants were shown by Mr. E. P. Roberts, of the class of 1877.

A dynamo and motor built by Mr. H. A. Corneman, while a student of the class of 1889 was shown.

Mr. J. W. Lieb, Jr., of the Edison Electric Illuminating Company of New York, exhibited several photographs of the electric lighting and railway system of Milan, Italy.

Mr. Joseph Wetzler, of the class of 1882, exhibited several books of which he is the author and some edited volumes of the *Electrical Engineer*. Mr. Wetzler is one of the editors of the latter periodical.

Several books on Röntgen rays and intention as a science were displayed by Mr. E. P. Thompson, of the class of 1878.

From the above it will be seen that electricity occupied by no means a minor position in this exhibition. The general lines upon which the electrical engineer is educated at Stevens is in accordance with the remark made by the president of one of the prominent electrical companies in the country, that "An electrical engineer must be 90 per cent. mechanical and 10 per cent. electrical."

An American Chimney for Japan.

According to *Engineering News*, Japan came to Philadelphia to buy a chimney for the electric lighting plant at Yokohama. It is a steel shaft 175 ft. high, 7 ft. in diameter and weighs over 90,000 lbs.

On the Deflection of Cathode Rays.*

BY JAMES MARK BARR AND CHARLES E. S. PHILLIPS.

The effects of exterior magnets upon the action of vacuum tubes have long been known. It is stated that the results are due to reactions between the magnetic lines of force and the streams of charged matter shot out from the cathode within the tube. Many experimenters, in working with the cross-shadow tube, noticed the total translation of the shadow when a magnet was brought near. The exact relative motions were not, however, definitely recorded until lately. The effect of an *axial* magnetic flux upon the cross-shadow, first published by Dr. Fleming,[1] is seen to be a twist-distortion of the image; but without translation.

This latter would seem to give an opening for the easy explanation of the reactions within the tube—retaining the usual conception of the magnetic field. But some new effects, observed by the writers, show very complicated relations between the cathode rays and the magnetic field; indeed, the usual ideas of magnetic whirls

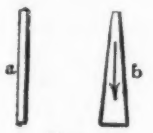


FIG. 1.
a, Shadow of Wire: No Current.
b, Current as Indicated by Arrow.

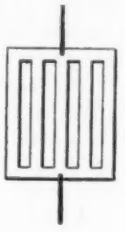


FIG. 2.

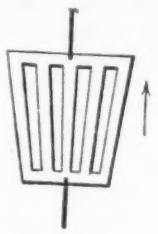


FIG. 3.

and of streams of charged ponderable matter fail to help one in explaining the phenomena.

When the anti-cathode was a straight wire its shadow became wedge-shaped when a current flowed in the wire, and the relative conditions were as follows:—The shadow *contracted* towards the end where the current entered, and *widened* towards the other end. This is indicated in Fig. 1.

The writers then examined the effects produced with an anti-cathode having the form shown in Fig. 2. Here one has means for noting any axial translation of the shadow; also the mutual effect, if any, of the parallel currents in separate wires. With no current in the anti-cathode the shadow was as shown in Fig. 2—a rectangular grid. Fig. 3 shows the change produced by a current along the grid. The image became wedge-shaped; widened towards the end where the current left, and contracted towards the end where the current entered. But besides this the whole shadow was *translated in the direction of the current.* It should be stated that the currents used varied from 10 to 20 amperes.

In the tubes used it was found to be immaterial whether the shadow-casting wire or grid acted solely as anti-cathode (there being a separate sealed-in wire for anode) or whether it served the double function as anode and anti-cathode.

The writers were then lead to the idea of examining the effect produced by a current in the cathode. At first sight it would seem likely to produce the same effect as a current in the anti-cathode, because the magnetic field is practically the same. With a view to such a comparative experiment, then, the tube shown in Fig. 4 was made. The electrodes were two similar flat platinum crosses, with leading-in wires, as indicated, and either cross could carry a cur-

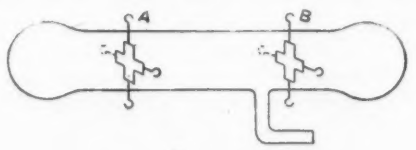


FIG. 4.

rent while one is the cathode casting the shadow of the other. Also current could be sent through both crosses at the same time, in the same or opposite directions or in directions at right angles to each other, and the effect on the shadow observed.

The effect when current was passed diametrically through *B* (Fig. 4) while *A* is the cathode, has already been indicated for the similar cases of the wire and grid anti-cathodes. But when the current passed diametrically *through the cathode A* the effects on the shadow of *B* were *reversed* in every particular. The shadow widened towards the end of cross where current entered; and contracted towards the other end. And the translation was backwards along the direction of current. With currents in both *A* and *B* the opposite effects neutralized one another when the currents were in the same sense. When the currents were in opposite senses the effects were augmented. Thus we arrive at a differential action, and currents can be balanced by a zero method.

* From the *London Electrician.*

[1] THE ELECTRICAL WORLD, Jan. 16, 1897.

Interior Conduits.

Among other questions considered by the National Conference on Standard Electrical Rules, in its endeavors to formulate a single national code of rules for safe wiring, was that of plain iron pipes versus lined pipes for interior conduits. At the December meeting of the Underwriters' National Electric Association its Electrical Committee also discussed the question of interior conduits with the result that a special committee was appointed to experimentally investigate the question for the purpose of determining the best conditions for their use. Inasmuch as the cost of interior conduits is one of the largest items in electrical construction, the methods which permit of the greatest economy consistent with safety are to be sought for. It is for this reason that THE ELECTRICAL WORLD has deemed it advisable to obtain an expression of opinion on this subject from various manufacturers, consulting and constructing engineers, and others more or less directly interested, and in response to a circular letter sent to the most prominent representatives of these various branches soliciting their opinions, the following replies have been received:

Mr. William H. Merrill, Jr., Electrician for the National Board of Fire Underwriters, regrets that his connection with the insurance interests prevents him from contributing to the discussion previous to the final action of the Underwriters' National Electric Association, but sends the following notes, which will doubtless prove of interest, being the results of investigations which he has personally carried on.

"Metal Conduits—The metal covering or pipe must be at least 1-16 of an inch in thickness, and capable of withstanding a crushing load one-half as great as that necessary to break the ordinary commercial forms of gas pipes having equivalent external diameters.

"The insulating lining

"1. Must be firmly secured to the pipe.

"2. Must not crack or break when a ten-foot length of the conduit is bent with a sag of two feet in the middle.

"3. Must not absorb more than ten per cent. of its weight of water during one hundred hours' immersion in pure water at 70 degrees Fahr.

"4. Must not soften at a temperature below 200 degrees Fahr., and must leave the water in which it is boiled practically neutral.

"5. Must be sufficiently thick and tenacious to withstand abrasion for five minutes against a 2¾-inch cylinder covered with No. 1 sandpaper and revolving at the rate of 1500 revolutions per minute, the material being held against the sandpaper by a ¼-pound weight.

"Plain iron pipe such as the ordinary commercial form of gas pipe must not be used as a conduit unless its interior surface is free from burrs and coated or enamelled to prevent oxidation, and the conductor installed therein has a covering sufficiently thick and tenacious to withstand abrasion for five minutes against a 2¾-inch cylinder covered with No. 1 sandpaper and revolving at the rate of 1500 revolutions per minute, the covering being held against the sandpaper by a ¼-pound weight attached to the end of the wire which is bent over the cylinder through an arc of 90 degrees. This covering must also show an insulation resistance of at least one megohm per mile after two weeks' submersion in water at 70 degrees Fahr. and three days' submersion in lime water after three minutes electrification with 550 volts. All such conduit installations must be permanently and effectually grounded.

"In the way of explanation, I would say that the cylinder used in the abrasion tests is sufficiently long to admit of a new surface of sandpaper being constantly in contact with the material tested, and differences due to a filling up of the sandpaper are consequently avoided. The instant of contact between the copper of the wire and the cylinder is given by an electrical signal.

"Over a hundred tests run according to this standard, show that it is well designed for purposes of comparison. The ordinary rubber wire coverings 3-64 inch in thickness, and having a braided outer covering will withstand this abrasion for from 30 to 100 seconds, varying with the make of the wire. Wires tested in plain iron pipes would consequently have to have a much thicker outer covering than the ordinary commercial forms in order to withstand

the abrasion for five minutes, as specified. The abrasion test on the conduit lining being the same, it follows that these test specifications take into consideration the use of this material secured to the inside of the pipe or the outside of the wire, as preferred.

"It is very likely that a better standard for thickness and tenacity will be devised, though I believe it will necessarily be a laboratory standard.

"In practice it might be preferable to use standard pipe sizes for insulated conduits, instead of the ones given, in order to render their installation easy with tools commonly employed, and because mechanical engineering practice has established these standards after long experience.

"If 'plain iron pipes' are ever allowed for conduits in practice, it would seem necessary to qualify their use somewhat along the lines of the restrictions given in these test specifications."

Mr. E. H. Johnson, president of the Interior Conduit & Insulation Company, New York City, writes that he believes the insulation should be both on the conductor and in the tube, and that it is better to have two independent insulations in lieu of a "single thread." He does not believe that a thin coating of asphaltic paint, enamel or other substance will be sufficient to prevent oxidation, moisture or abrasion of the insulation on the conductor, as he believes there is no such coating of sufficient endurance. He states that an extra protective covering on the insulation of the wire, in addition to a thin coating of asphaltic paint, enamel or other substance in the tube is not sufficient, inasmuch as it simply means one insulation liable to one particular set of conditions of damage. He believes that a lead covering is a greater detriment than advantage under any circumstances, and it is not a proper or scientific way of protecting the insulation. He does not believe in having a lining for the purpose of acting as a distance-piece between the tube and the insulation of the conductor. He believes in an insulated-lined conduit, the insulation resistance of the lining being depended upon as an additional safeguard, and that the best obtainable relation should exist between the insulation on the conductor and that of the tube, and that a coated metal tube is insufficient.

Mr. George Hill, 44 Broadway, New York City, states it is his belief that the proper form of conduit is an unlined galvanized iron pipe, installed with proper care, but he has not had the opportunity to conduct experiments which would enable him to ascertain how far his belief is justified by the facts.

Mr. H. H. Brooks, manager of the American Circular Loom Company, Boston, Mass., writes that he is "last and always in the interests of an insulated raceway having no joints or molded elbows, or, in other words, a system furnishing the simplest safe means of producing the required effect."

A prominent insulated wire manufacturer writes that as a large portion of incandescent lighting is by alternating currents, and inasmuch as it is better to have both conductors in the same conduit, individual wires should be well insulated, and if sufficiently insulated he can see no advantage of having an insulation in the tube. With either direct or alternating currents, if the wires are well insulated, as many may be run as is desired through the same conduit, the conduit only being required as a pathway and protection from mechanical injury. A thin coating of asphaltic paint seems to protect pipes from water, gas or steam better than anything else of moderate cost, and certainly should protect them from oxidation. The collection of moisture is caused by condensation due to a fall in temperature, so that a thick coating of paper or other poor conductor of heat might delay condensation, but will probably not prevent it. If an absorbent, it might prevent the moisture from dripping into the bends and traps of the conduit, but the absorbent properties would not only reduce the insulation, but hasten disintegration. If the inside of the pipe, including the joints and bends, should be perfectly enamelled by a highly insulating material, without adding materially to its cost, it would be desirable.

If a conductor is protected with a good cotton braid thoroughly saturated with a proper wax compound, there should be no danger of serious abrasion in drawing in, especially since such conductor may be made flexible by using strands of fine wires, without very materially increasing the cost. A lead encasing should be used on insulated wire where there is danger of exposure to gas, grease, naphtha or special enemies to rubber, but it adds very much to the difficulty of drawing in, and if good rubber is used is not necessary, except as above indicated.

In reference to a lining acting as a distance-piece between the metal tube and the insulation of the conductor, he believes that ordinary covering is all sufficient for the purpose. He believes that rather than have an insulated-lined conduit, the insulation resistance of the lining being depended upon as an additional safeguard, it is much cheaper and better to add a little good rubber to the compound as an additional safeguard. He believes that an iron or steel tube should be treated with that substance which will at reasonable cost best protect it from oxidation.

Another prominent wire manufacturer writes:

"It seems to me that insulating the conduit and insulating the wire is not the proper thing to do. If the conduit is to be insulated, then the wire should be bare. If the insulation of the conduit is not good enough for this, it is not good enough to be of any practical use, because with one weak place it is no better than a bare pipe. It therefore seems to be a question in my mind of insulating either the wires or the conduits, and it seems to me the proper thing is to insulate the wires. We find no difficulty whatever in underground work in pulling in long lengths of heavy cable, and see no reason why in house wiring there should be any danger of injuring the insulation when installing the wires. In putting in a system of house wiring, I should thoroughly connect all the pipes. The main danger from fire seems to be a pipe partially insulated containing a live wire in contact with the pipe. In other words, dangers of fire are to be looked for from the outside of the pipe and not from the inside, and the proper method to use is a method which will confine any arcing to the inside of the pipe. By having the various pipes of a conduit system thoroughly connected together, if any ground should occur on the negative or positive leads at the same time, then any arcing due to imperfect contacts would occur on the inside of the pipe, and the difficulty would be at once shown in the circuits by the blowing of fuses or other safety devices.

"A conduit should be made of such material as offers mechanical protection to the wires and of affording an easy method of drawing in and drawing out. It seems to me that the best thing that could be used for house work is ordinary gas or water pipe. All insulated wires to be used in these pipes depends very much on the conditions and the opinion of the engineer in charge. It is perhaps better to divide such wires into three classes: Fire-insulated wires, such as weatherproof or underwriters'; rubber-insulated wires and lead-covered wires, the insulation of which may be either rubber or fibre. If the conduit in the house is going to be dry at all times, it is my opinion that a fibrous-insulated wire is as good as any other kind of insulation, with the advantage in its favor of being cheaper. If the conduit is to be exposed to moisture, then a rubber-covered wire or a lead-encased wire is the only thing to be considered. A fibre-insulated wire covered with lead is perfectly good for places, no matter how damp they may be or how wet, as long as the lead covering remains whole.

"A rubber-covered wire, lead encased, has the advantage of two protections against moisture, the lead covering and the rubber insulation, which also serves to protect the rubber from the dangerous effects of the air, which in time causes the rubber to become brittle and useless."

Mr. J. W. Marsh, vice-president of the Standard Underground Cable Company, New York, writes that he believes that the insulation should be on the conductor, and that for all practical purposes nothing is gained by having an insulating-lined tube except in the case of ordinary waterproof wire where the interior conduit might become filled with water or much condensation of moisture might occur; a thin coating of enamel would be sufficient to prevent oxidation of the conduit and abrasion of the insulation, but neither asphaltic paint or enamel will prevent the collection of moisture. If cement or paint or similar substance is used for coating the conduit, there would be more risk of abrasion than in the case of a smooth, bare iron pipe. He believes that a thin extra protective covering on the insulation of the wire would be sufficient, but does not believe it necessary to have lead-covering on the wire if limited to interior conduits used in buildings and so well disconnected from the underground conduits that no gases can enter the interior system; otherwise, a lead-covering is absolutely necessary. He does not believe that it is necessary to have a lining acting as a distance-piece between the iron and the insulation of the conductor if the latter is properly insulated. He believes that with properly insulated wires no additional safeguard such as an insulating lining is necessary, but that the insulation of the conductor in itself should be adequate for the service required. He believes that the iron or steel tubing should be so protected as to prevent its corrosion and with a substance that will under all conditions of heat, cold, etc., present a perfectly smooth surface.

Mr. H. Ward Leonard, of the Ward Leonard Electric Company, Hoboken, N. J., writes:

"I believe that I was the first person to urge the use of the two wires of the circuit in a plain iron pipe, and in 1893 I installed many thousands of lamps wired in this way, with entirely satisfactory results to date, as far as I know.

"I think that the conduit should have no inflammable material, or material which in case of fire would 'add fuel to the flames,' and as far as it is possible the same is desirable for the wire.

"Exceedingly high insulation is of less importance than insulation which will remain unaltered in the course of years.

"The most important feature of a good conduit is mechanical strength and the ability to withstand, without alteration, exposure to the chemical conditions met with in modern building construction. These features we know by experience are possessed by an ordinary gas pipe.

"The iron pipe system in the building with the two poles of the circuit in it, should be grounded throughout so that no difference of potential can exist between different portions of the pipe system without operating a safety device.

"The greatest fire risk is due to small leakage currents too small to operate a safety device, but large enough to cause serious troubles from electrolytic action, which ultimately results in reducing the positive conductor so that it is melted by the normal current, and causes an extremely dangerous arc, fed by the full E. M. F. of the circuit. This is not a new theory, but an established fact, and yet it cannot be stated too often or too forcibly, for the danger due to it is not sufficiently well appreciated.

"I consider all conduits other than metal ones worse than none at all when they are embedded in the walls of a building.

"The perfect conduit would be a strong metal pipe, lined with a smooth incombustible, highly insulating but thin wall of material, which could not be affected by any chemicals.

"I advocated such a conduit as this some time ago, but at the time paper tubes or canvas tubes, with one wire in a tube, were the standard, and the conduit I urged met with no favor.

"It was a gas pipe lined inside with porcelain enamel. Such a conduit is perfect when in place. The strongest criticism that can be offered against it is that it cannot readily be bent, but the best work done to-day is laid out in the office, and the tubing is cut to the exact lengths required, and the workman merely couples together the proper lengths. Under such conditions no bending is necessary. If bending is essential, even this could be done with a porcelain-lined conduit by heating it to a red heat and then bending it.

"With such a conduit the insulating lining would be just as good fifty years hence as to-day. It would not get sticky and bind the wire throughout its length when close to steam pipes. The insulating wall would be only about 1-32 inch thick, so the outside diameter of the pipe would be small, and yet the insulation would measure many megohms and would withstand the piercing action of over 2000 volts.

"The smooth glassy surface would make it easy to pull wires in and out, and in case of fire from any cause the action of the conduit would be entirely negative.

"Probably we have not yet reached the porcelain-lined conduit in the commercial evolution which is so rapidly going on.

"The iron pipe, however, has come to stay. Whether it will be used plain or porcelain lined cannot be fairly judged to-day, but I believe it will be one or the other."

Mr. Edward R. Knowles, 423 Tract Society Building New York City, writes that the insulation should be on the conductor, and that nothing is gained by having an insulating-lined tube. He believes that an asphaltic paint or other substance may be sufficient to prevent oxidation, the collection of moisture and the abrasion of the insulation on the conductor, if the pipe is smooth on the inside. The pipe system should not be hermetically sealed, but open at proper points, so that it can be ventilated and drained if necessary. He believes that the insulation of the wire, in addition to a thin coating of asphaltic compound, enamel or other substance in the tube will be sufficient. The wire should be the best obtainable.

He does not believe in a lead covering on the wire, neither does he believe in having a thick lining acting as a distance-piece between the metal and the insulation of the conductor. All that is necessary, in his opinion, is a plain iron or steel tubing coated with asphalt or some other substance sufficient to prevent rusting.

"I have had in operation for nearly a year two complete plants, both of which are installed entirely in plain iron gas pipe coated with asphalt inside and out, the wire used being the best obtainable on the market, and these two plants show and have shown the very highest possible conditions of insulation, and are absolutely satisfactory in every way. There is not the slightest doubt in my mind that this is the proper way to install a conduit, putting the insulation where it is needed, on the wire, and I believe the time is not far distant when all conduit work will be installed in this manner."

Mr. George A. Hamilton, New York City, writes that he should insist on the insulation of the wire as the prime requisite, the kind of tube to be used being of secondary importance, his preference being, however, for iron. "The insulation of the tubing itself, from an electrical standpoint, is a safeguard not to be disregarded perhaps, but likewise not to be much depended upon. Paint, enamel, etc., may, and doubtless do, retard or prevent rust, but in my opinion are of no value against the condensation of moisture within the tube. As for lead covering, I should consider its use necessary only in places where the insulation is of a nature to absorb moisture, or otherwise is likely to be subjected to elements that affect it injuriously."

Mr. H. B. Coho, of H. B. Coho & Co., 203 Broadway, New York, writes:

"Replying to your favor of the 2d, we beg to say that, in our opinion, a wire carefully insulated and placed in a plain iron pipe with the circuits and branch circuits properly protected by fuses and circuit breakers, as now demanded by the Fire Department, makes as complete and safe an installation as can be desired. The various substances placed in the iron as lining serve, in many instances, to make it easier to draw the wires, but we cannot see how, in any other respect, the installation can be improved.

"We believe in high-grade insulation for our wires and their careful protection by iron pipe from mechanical or external injury, and when due precautions are observed along these lines, we think the principal object of iron pipe has been accomplished."

The Enclosed-Arc Lamp.

To the Editor of The Electrical World:

Sir:—As the enclosed arc has taken a clearly defined position in the art of electric lighting of to-day, it is interesting to note the appreciation by scientists in the early days of commercial arc lighting of what we know to-day to be its essentials. The articles which have appeared in your paper by Mr. Marks, are interesting as showing the development of this improvement, and from these articles it is quite evident that the utility of the enclosed-arc depends solely upon the capacity of the apparatus to slowly replace the effete products by air, the change being gradual and capable only of maintaining life and clearness to the enclosed atmosphere in which the arc is maintained, without the rapid consumption, which is the result of unlimited quantities of air being supplied to the electrodes. This, then, is the secret of success of the enclosed arc, and while these features have been, by the articles referred to, accredited to recent date, they were as a matter of fact fully known, illustrated and described by Prof. Elihu Thomson, in 1879, and also known to others at that time to be his invention. Among the evidence of this was a most complete specification for an application for letters patent prepared in February, 1879, in the handwriting of Prof. Edwin J. Houston, and signed by both Profs. Thomson and Houston, which became evidence in an interference proceeding between Prof. Thomson and myself, upon the question of priority of invention of another matter. In this writing is described the advantage of excluding almost all fresh air from the enclosing globe to reduce the consumption of the electrodes and increase the longevity of the arc from a pair of carbons. Furthermore, means is shown and described to insure the very slow and gradual supply of air and escape of products of combustion so necessary to avoid blackening and bursting of the globe. In addition to this, the lamps are shown as arranged for constant potential circuits. While all this may be deemed as too ancient to be considered more than as historical, nevertheless, it shows how possible it is for an inventor of the character of skill possessed by Prof. Thomson to foresee the necessities likely to arise in the future. This evidence, it seems to me, shows Prof. Thomson to be the first to devise and suggest the essentials for successful working of the enclosed-arc.

Philadelphia, Pa. R. M. HUNTER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Commutatorless Continuous Current Dynamo. PONCIN. Lond. *Elec. Rev.*, Feb. 12.—A short communication in which he states that at least one of the fundamental rules of magnetism and electricity is entirely wrong (!) and he therefore tried something different from what present rules would suggest. A very small dynamo was first constructed for the purpose of testing his reasoning, and as it gave the expected results a 200-hp dynamo has since been made; he hopes at an early date to give a full description of it and of the tests as well as of its theoretical explanation.

Alternator. Lond. *Elec.*, Feb. 12 —A well illustrated description of the new form of Mordey inductor alternator. The Lond. *Elec. Rev.* also contains a short article with some of the illustrations.

Dead Wire on Armatures. PFUND. *Elec. Eng.*, Feb. 10.—A short article concerning the dead wires on armatures and being a continuation of the discussion between Anthony and Hering in some back volumes of that journal; in that discussion Hering had described some experiments showing that there is little or no E. M. F. induced in the wire on the inside of the gramme ring, while most of the voltage was generated in the wire on the outside; the illustration is reproduced; Anthony claimed that the E. M. F. developed in the coils is determined by the rate at which lines of force are taken into or excluded from the area enclosed by the wire. Pfund claims that there is another way of looking at this matter, and that there may be entirely different reasons for the wire on the inside being dead; he states that the larger the diameter of the ring and the nearer the cross section corresponds to the carrying capacity for lines of force, with reference to the field, the more active the wire on the inside becomes, but that in no case can it be entirely equal to the wire on the outside; he illustrates his reasoning with some diagrams (in some of which he omits the consideration of the return circuit, which is important in his method of reasoning); he claims that if the same number of lines of force are on both sides of a single wire no E. M. F. will be generated, but if there are more on one side than on the other there will be an E. M. F.; he concludes that Anthony's claim no doubt holds good with all practical cylinder armatures, but that in ring armatures allowance must be made for the lines through the centre of the ring.

Incandescent Lamp Question. BUSSMANN. *Elek. Zeit.*, Jan. 28.—An article replying to the one of Gusinde (see *Digest*, Jan. 16), and to the one by Riggert. (See *Digest*, Jan. 23). He discusses the specifications of the Hanover station referred to in the first paper, from the standpoint of the lamp manufacturer. He questions the meaning of the expressions, normal candle-power, normal voltage, etc.; the allowable variation of 6 per cent. in the candle-power and consumption of energy, he claims to be unquestionably too small; the only matter of interest to the consumer is that the lamp does not differ as much as could be detected by the eye, and it is impossible to thus detect a difference of less than 25 per cent. in the candle-power; the limit of 6 per cent. means that the voltage must be determined to an accuracy of 1 per cent.; such an accuracy is not possible in manufacturing a product like the incandescent lamp; regarding the photometric measurements, it was stated that they were to be made according to the usual rules, and the present writer questions whether there are any such usual rules; the most accurate adjustments of the photometer gives rise to errors of 8 per cent. in the candle-power; he claims that there are much more accurate methods existing for determining the mean horizontal intensity than the method of measuring the intensity in two directions, as prescribed in those specifications; the apparatus used in that station does not enable measurements to be made with the accuracy given in the specifications; he favors the Lummer-Brodhun photometer, claiming it to be much more accurate than the usual grease-spot apparatus. In conclusion, he shows from the results of experiments, that an increased amount of energy in the filament does not give a greater uniformity in the emission of the light in different directions, as was claimed in those specifications.

LIGHTS AND LIGHTING.

Theatre Lighting Controllers.—Elec. Jour., Feb. 15.—An illustrated description of the method used in the great Northern Theatre at Chicago for gradually dimming the lights; the motive power is compressed air by means of which a sliding contact on the rheostat drums may be moved very gradually or suddenly.

POWER.

Lachine Rapids Power Plant.—Eng. News, Feb. 18.—A long illustrated description of this power plant, limited chiefly to the civil engineering features.

TRACTION.

Side Trolley System at Chalons-sur-Marne.—L'Energie Elec., Feb. 1.—A long, illustrated description of this line, which was recently inaugurated; the chief feature of interest is that the Dickinson system of trolley wire suspension and trolley are used; it is the first application of that system in France; around corners and in narrow streets the trolley wire is secured to brackets on the sides of the houses and on wide or open streets, where this is not possible a pole with a short bracket is used, the wire being over the side of the street; this involves the use of a pivoted trolley wheel, an illustration of which is given, but the description of the method of supporting the pole is not very clear; this system reduces the number of poles to a minimum and makes all transverse wires unnecessary.

Mounting Heavy Grades. MOLLARD and DULAC system. *L'Ind. Elec.*, Jan. 25.—An illustrated description of this system, which is intended to replace the one in which short, steep grades are mounted by an elevator or inclined railway, requiring passengers to change cars twice. In the present system there is an endless cable, which moves above the surface of the street over the steep grade, and the cars are provided with an improved form of grip, an illustration of which is given; it is said to grip tighter the stronger the pull; the system is in use at Lyons on an electric trolley line; the cable is operated by an electric motor; the grip is connected with the car through springs: they also use an improved system of automatic brake, which clamps a fixed cable.

Railway Power Distribution in Eastern Massachusetts. St. Ry. Rev., Feb. 15.—An article pointing out what has been done on some of the extensive networks of lines in the eastern part of Massachusetts, where nearly every variety of problem in electric railway feeding presents itself. The Lynn & Boston Line, whose experience is discussed at some length, was one of the first to connect its power stations together for equalizing the load between them; the connections are made between ends of the trolley wires by "jumping" the section insulators; the circuit breakers on the feeders supplying those sections are set for a very heavy current, only a little less than that required to open the generator circuit breakers; this road also adopted the plan of running some feeders at a higher voltage than others, although both feed into the same sections; the plan has given no trouble whatever, and there is no danger of one set of generators feeding back into the other. On the Lowell & Suburban Railway a three-phase transmission at 5000 volts is used, which is transformed down to 375 volts and then into 500 volts direct current by rotary transformers at a sub-station ten miles distant, and at another fifteen miles distant; at first, generators were used which gave both direct and alternating current, the former being used for excitation, but these are now being replaced by separately excited machines; some of the line construction is discussed. The West End Street Railway operates all its power stations in multiple through "jumped" section insulators.

Current Consumption of Motor Cars under Various Potentials CHAPMAN. *St. Ry. Rev.*, Feb. 15.—A short article in which he gives the results of some experiments made with a view to finding the relation of the line voltage and the amperes, in terms of car miles; the results, which are given in a short table, are claimed to show plainly that at low voltage the ordinary street-car motor consumes less current and that the energy required to move a car a mile, in watt-minutes, is less at low potential than at normal, while the ampere minutes per car mile increases as the voltage diminishes; he concludes from this that cars can be operated more cheaply with the 500-volt station potential than with 550, provided that the "slight" loss in speed does not require more cars to be used; the saving in energy amounts to 22 per cent. in a reduction from 520 to 320 volts. (He does not seem to give sufficient importance to the question of speed, which of course is reduced, for a lower voltage; it is well-known that a car will require less energy to run it over a mile at a low slow speed than at a higher one.)

Budapest Underground Electric Road.—Eng. News, Feb. 18.—A note stating that this line, which was opened May 1 of last year, carried 2,261,940 passengers up to Oct. 1, the single car mileage being 229,302 miles. The city obtains no revenue during the first twenty years, but after that it receives a small percentage of the gross receipts; the road and rolling-stock were illustrated in that journal March 21, 1895.

Alternating Current Traction Plant.—West. Elec., Feb. 20.—A note stating that specifications are about to be issued for a sixty-mile line from Detroit to Port Huron through St. Clair and other cities; it will be used for passengers, mail and freight, and will possess unusual scenic attraction; there will be fifteen motor cars and fifteen trailers; two-car trains will be run, the cars being 46 feet long; the motor-cars weigh 33.5 tons and the trailers 20 tons; probably each motor will have 200 to 300 hp capacity in motors for a maximum speed of sixty miles an hour, the schedule time being forty-five miles; it is thought to be the longest electric railroad in the country; there will be but one generating plant, the alternating current from which will be converted in four sub-stations by rotary transformers, into direct current for feeding the line.

Chicago City Railway Power House.—West. Elec., Feb. 20.—A brief description with a plan and section of the new power house, which is claimed to be probably the largest in the country and one of the largest in capacity, 7500-hp being the amount which is at present being installed.

Conduit Road in Chicago.—West. Elec., Feb. 20.—A note stating that an underground conduit system is to be constructed on the South Side, Chicago, the work to begin as soon as the frost is out of the ground; it appears that the Love system is to be used.

Operating Expenses of Connecticut Roads in 1896.—*St. Ry. Rev.*, Feb. 15.—An extract from the report of the Railway Commissioners, giving the tabulated results of quite a number of roads.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity Supply at 230 Volts. GIBBINGS. Lond. *Elec. Rev.*, Feb. 12, and *El'ty*, (N. Y.), Feb. 17; the beginning of a reprint of a paper read before the Northern Society of Electrical Engineers in England.—He describes his experiments at the Bradford station where he had made the change from the ordinary voltage to 230; he assumes that the advantages are now well understood and limits himself chiefly to his experience with the consumer and the fittings. About 500 consumers changed over from 115 to 230 volts since November, 1895; this is the first station which has completely gone over to the high pressure system. Regarding the house terminal fuse boxes he found the length of fuses amply sufficient and the insulation satisfactory; some types of meters had to be abandoned; the alterations in the Thomson-Houston meters are briefly described; regarding wiring and fittings, he states that now the insulation resistance is invariably maintained in a more perfect condition than before and that there has been much less leakage; the high pressure, instead of causing unpleasant troubles, has actually freed the management from much of the searching for earths which was so frequent before; the more modern types of the ordinary 115-volt fittings are equally satisfactory at 230; the ceiling rosettes, switches, wall plugs and fuse fittings have in some cases required renewal and have given trouble; the faulty ones were replaced by the ordinary, good, modern types; no special fittings have been made; the fuse fittings constituted the principal failures owing to the usual very short break gap.

Alternating Current Switchboard. ANDREWS. Lond. *Elec. Eng.*, Feb. 12.—A discussion of his recent paper; see *Digest* last week.—The speakers all praise the paper and the ingenious devices; they give their own experience in similar installations; the discussion does not seem to be of any great importance. Ferranti stated among other things that the nicest way of getting machines into parallel was to have the revolving part of the machine painted with as many white lines or spots as there were field poles, and if the station is then lighted with alternating arc lamps fed from the bus bars, the lines will be seen to move backward when the machine was at less than synchronous speed and forward when above; the advantage of this is that the engine-driver has a perfect knowledge of what is taking place; the method is used in the Portsmouth station and is being introduced into several others where the switchboards are some distance from the dynamos; he favors water-break switches; he disagrees very decidedly with the recommendation to excite all alternators by a common exciter; he favors a diagram of the switchboard where it is readily accessible, the switch-gear itself being as far as possible its own diagram; he thinks the ingenious apparatus of Andrews had to be used because the particular plant had to be dealt with in this delicate manner; alternate machinery is now becoming much more reliable. Cowan thought magnetic cut-out would have too much inertia and be slower in action than a fuse; he agreed with Ferranti that separate exciters are preferable. Andrews in his reply stated among other things that he had used separate exciters and had abandoned them as the excitation was sometimes uneven.

System of Charging.—Lond. *Elec.*, Feb. 12.—An editorial comment on the suggestion by Wright (see *Digest* last week).—His system with the demand-indicator, though very good, is not universally applicable in its naked simplicity, as was shown at Hastings; the unusually low rate of three cents is deceptive; the real price may run up to fourteen cents even at Brighton, as it depends on the way in which the current is used; with this system it may be practically impossible to decide whether an electric motor or a gas engine would be cheapest; the principle of having a fixed rental per horse-power, plus a charge in proportion to the energy consumed, has much to recommend it to the Company; this has been adopted at Bristol, where a charge of four cents per unit is made for motive power, plus a rental of $30 per year per kilowatt; the change is of advantage only to those consumers who use their motors more than 720 hours per year, and with this number the annual cost of the kw-hour would be $60.

Electric Preparation of Welsbach Mantles. LANGHAN'S SYSTEM. Lond. *Elec.*, Feb. 12.—A brief description of his system in which an electric current is used in the manufacture of mantles. Heretofore there has been a difficulty in depositing the oxides electrically in the adherent form; a solution of an earthy hydroxide in one of its neutral salts, say a sulphate of its own metal or of any of the other metals of the group, will form an electrolyte which yields an adherent, horn-like deposit of the hydroxide, which will bear rough handling; this is readily converted into the oxide by heat; the process is carried out in a cylindrical vessel with a thin cylinder of platinum as the anode, the mantle forming the cathode and being also a porous diaphragm containing a saturated solution made by dissolving the hydroxide of the metal in a concentrated solution of its own sulphate or nitrate; the addition of a small quantity of nitrate is always desirable; the vessel contains an aqueous solution of the hydrate or carbonate of the metal; the mantle should be dried in air free from carbonic acid; the deposit may consist of the hydroxide of the single metal or a mixture of several of them; the minimum current density per sq. cm. for the 20 per cent. solution of the salts of zirconium and thorium, is 1.66 amperes, of yttrium 1.25 and of aluminum 0.75; it is usually best to employ nearly double this current density; for a thick coating, alcohol may be substituted for the water, as a solvent.

Municipal Plants.—Elec. Eng., Feb. 17.—A large portion of this number is devoted to various articles for and against municipal plants. The greater portion is a reprint of a long report by Winchester to the Special Investigating Committee on Commercial Electric Lighting in South Norwalk, Conn. In a brief introductory to the report he states among other things that municipal plants are in the minority in this country while they are a majority in England; there are to-day in the United States over 300 such plants, an increase of 100 per cent. in about two years, and which with but rare exceptions give most gratifying results in the way of economy and satisfaction, as is shown by the large number of answers to about 200 letters of inquiry which he sent out; he states that there is scarcely a city of importance which does not already possess such a plant or is building one, or considering the matter, except in the very large cities; he calls attention to the opposition to municipal plants shown in the electrical periodicals, few of which he says dare to encourage or defend such undertakings; he gives the reasons favorable to a municipal plant, and states that he has given this subject a most searching and prolonged study. He then quotes from the answers received from quite a number of municipal plants in the United States, most of which show very gratifying results; he also gives an estimate of a low tension system for South Norwalk, showing that if the city constructed its own plant there would be a net saving of $3,378.00 per year.

Among the other notes and short articles in that issue are the figures from the official report of the City of Utica giving the cost of lights in a long list of cities in which the plant is owned by the municipality, and of others owned by companies, on the strength of which a five-year contract for 33 cents per night with a private company was recommended. Opinions of various parties on the subject of municipal plants are given; also other discussions on the subject including experiences at some municipal stations; (most of the matter, with the exception of the first report, is unfavorable to municipal plants); the subject is also discussed editorially; although praising Winchester's report it is editorially claimed that it betrays a poor case and confirms the suspicions held by that journal as to the general ignorance on the part of municipal plant managers; it is claimed that in most instances the balance sheet is decidedly unfavorable, and in many there appears to be no knowledge of the vital factor of depreciation.

Report of New York Edison Co.—Elec. Eng., Feb. 17.—An extract from the annual report showing a healthy growth.

WIRES, WIRING AND CONDUITS.

High Voltage Fittings.—Lond. *Elec. Eng.*, Feb. 12.—Illustrated descriptions of a switch, wall plug, ceiling rose, lamp holder, and cut-out board, for circuits of 150 to 250 volts.

Calculation of Circuits. PERRINE. *Elec. Eng'ing*, March.—A very long article devoted mainly to the calculation of the circuits; some of it is elementary. In describing the principles underlying the calculations, he gives reproductions of four graphical diagrams, namely, those by Stark, Badt, Hering and Perrine, in the form of full-size plates. He describes at some length the operation of graphical multiplication and division. A table is given showing the class of conductors to be used under various conditions; the heating of the wires is discussed and a number of tables of the carrying capacity are given; in conclusion he gives some general formulas for calculating branching mains.

ELECTRO-PHYSICS AND MAGNETISM.

Mechanical Conceptions of Electrical Phenomena, and Researches with Resonance. HEINKE. *Elek. Zeit.*, Feb. 4.—A very long article in which he describes simple mechanical methods for conceiving what takes place in an electrical phenomena; his method may be said to be a development of Maxwell's method of treating electrical problems; he shows how even difficult problems can be represented by mechanical analogies; of special interest is the theoretical treatment of the phenomena of resonance which forms the latter portion of the article; the mathematical deductions are all comparatively simple. Every material, whether a solid, liquid or gas, can be supposed to be made up of two fundamental elements, namely, the material molecules which may be conceived as whirls, and the much smaller, spherical, electrical, particles which surrounded them; the whirls might be supposed to be swimming amongst the electrical particles and surrounded by them, each whirling molecule being completely surrounded by these little particles; he gives as an analogy a honey-comb, in which the wax walls are the ether or electrical particles, and the honey the material whirls; both are supposed to act on each other like friction wheels, the motion of one wheel being thus transmitted to the other through the electrical particles. In electrical conductors these small, electrical particles, which he calls friction molecules, on being subjected to a so-called E. M. F. can wander between the material whirls, which then represents the electric current, while in insulators they cannot wander; the friction molecules, or electric particles, are assumed to be absolutely incompressible; the different specific conductivity of materials is represented by the different friction coefficient between the friction molecules and the whirl molecules, of each material. The magnetic properties of all materials may be represented by the direction and intensity of the material molecular whirls; the different magnetic strengths of different materials is then represented by a different directive force; all magnetic energy, such as hysteresis and the like, can also be explained by the mechanical properties of the whirls, but this he passes over; magnetic lines of force can also be represented, their direction being the direction of the axes of the whirls connected together like beads on a string; the number of material whirls, or molecules, however, is not variable, and a change in the lines of force, or intensity of magnetization, is then represented by a change in the intensity of the whirls; what is commonly called the number of lines of force is then the product of the constant number of polarized rows of whirls and the variable strength of the whirling intensity; these material magnetic whirls have inertia which shows itself

in the production or destruction of a field; self-induction, like inertia, causes a following of the action behind, or later, than the cause. He illustrates a number of these conceptions with simple diagrams. He then considers capacity in connection with alternating currents; the friction molecules or electric particles in a dielectric cannot move or wander, but analogously to what happens in a rod under tensile strain, the particles may, under the influence of electric pressure, be shifted slightly in position, being held back by an elastic string, which causes them to return as soon as the electric pressure is removed; the particles may be supposed to be held in place by india-rubber threads. He then considers at great length the subject of resonance, discussing it mathematically with the aid of these mechanical conceptions. There are three kinds of electrical resistances, the ohmic, the electro-magnetic inertia in the form of self-induction, and the elastic dielectric resistance in the form of capacity; when these are all three combined in the same circuit, say in series, they give rise to the effect called resonance; he illustrates this with a mechanical model in which an endless string passing over four pulleys, forming a rectangle, is given a reciprocating motion by a crank; one portion of the string is attached perpendicularly to an elastic diaphragm representing a condenser, another imparts its motion to two heavy flywheels representing self-induction, and another part is subjected to mechanical friction. In discussing resonance theoretically, he shows that it can be made as strong as desired by making the resistance correspondingly small; he gives a large table showing the dependance of the resonance on the various values of the factors in these formulas. He then describes experiments in which the resonance was measured; by producing the most favorable conditions as determined by his formulas, he arrived at much higher values of the resonance when the three above-mentioned forms of resistances are in series he obtains what he calls a voltage resonance, and in his experiments he finds that the forces developed by resonance were more than 30 times as great as the E. M. F. of the generator in that circuit; also, that the currents in the branches of a divided circuit were each more than 10 times as great as the undivided current, as was shown by ampere meters in the various circuits. He then discusses what he calls current resonance, which is obtained when the self-induction and the capacity are not in series, but in parallel; in the mechanical analogy of this case he uses water pipes in place of the string in the other model.

Foundations of Electro-Dynamics. Wiechert. *Proc. Lond. Phys. Soc.*, January; abstracted at considerable length from the *Wied. Ann.*, 59, p. 283.—A highly mathematical article, in which he claims to draw the following conclusions: "The necessity of regarding H as a rotor. We are to regard the field and rotor as playing opposite parts. The field is to be regarded as uninfluenced by the motion of matter as such. This is shown by the aberration of light and other phenomena. But change of the field alters the structure of matter, and this alteration of structure alters the field, so that the influence of matter on the field is only indirect. This conclusion is confirmed by the phenomena of the Rontgen rays, which can best be explained as due to vibrations so rapid that they have not time to produce such alterations in the structure of matter as are produced by ordinary light-vibrations, and which in their turn influence the latter. Furthermore, this independence of the field on the motion of matter points to the conclusion that the actual carrier of electromagnetic excitement is not matter, but another medium, namely ether."

Electric Conductivity of Polarizing Substances. Bose. Lond. *Elec.*, Feb. 12.—A reprint of a Royal Society paper in which he described experiments, chiefly with the polarizing substances, nemalite and crysolite; he found that the direction of absorption in these substances is the direction of greatest conductivity, and the direction of transmission, the direction of least conductivity; a table shows how the difference of absorption in the two directions is related to the corresponding difference in the conductivity; his experiments seem to show that a double conducting structure as a rule exhibits double absorption and consequent polarization.

Discharge. Wesenbonck. *Wied. Ann.*, No. 2; noticed briefly in the Lond. *Elec.*, Feb. 12.—A study of the discharge from points; he arrives at the novel conclusion that in hydrogen the discharge potential is not lower for negative than for positive charges, but that the quantity of the negative discharge is much greater at a lower potential.

Discharge Rays. Hoffmann. *Wied. Ann.*, No. 2; noticed briefly in the Lond. *Elec.*, Feb. 12.—These rays are contained in open air spark discharges but not in the brush discharge; they exert no photographic action or ordinary fluorescent effects; they proceed from all points of the spark track, but especially from the cathode; tney proceed mainly in straight lines; reflection by solids cannot be observed; they are strongly absorbed by oxygen and carbonic acid; they cannot penetrate metallic solids and are intercepted by mica, quartz and fluorspar; they are more intense from discharges at low pressure; they proceed from every part of the discharge; at high vacua they give rise to X-rays; they are not deflected by the magnet; they appear to be another link between light and X-rays.

X-Rays. Turner. Lond. *Elec.*, Feb. 12.—He shows a tube having three electrodes, one at each end, and another at the middle, connected to the reflecting plate; one of the end terminals is a wire which is continued almost to this reflecting plate; the resistance, as judged by an alternative spark-gap, is less between the two farthest electrodes than between the two nearest; a profusion of X-rays is given in the first case and to a less extent in the second, even when the resistance has been properly brought down; the long electrode is made of aluminum wire and does not terminate in the plate within the tube. Lodge has stated that the more positive the platinum target can be made the more efficient the tube will be as a generator of X-rays, but in this case the tube works best when the platinum mirror is quite disconnected from the coil. He examined the relative sensitiveness to X-rays, of ordinary and extra rapid photographic plates, and finds scarcely any difference.

Transparency of Gas to the X-Rays. Benoist. *L'Eclairage Elec.*, Jan. 30; an abstract from the *Comptes Rendus*, 134, p. 146.—It was at first thought that the capacity of different bodies for these rays increased with their density, and that there existed a simple relation like direct proportionality; but such a relation does not exist for the solids; he describes experiments made with gases and found with sulphurous acid, chloride of methyl and air, that the absorption is proportional to the density of the gas. He uses the term specific absorbent power for that of a layer "the thickness of which represents a unit of mass per sq. cm of surface" and then shows that this is a constant for gases at a given temperature and pressure, and for one kind of ray; he believes the variations of this constant can be used for differentiating the rays. He compares this constant with that for different bodies; for gases he obtains the value 0.14; for aluminum it is 0.09, showing that this metal nearly satisfies a general law of proportionality between the absorbing power and the density; silver, on the other hand, gave 0.84, which is six times too great; the difference appears to increase with the density of the solid bodies; for gases the absorption diminishes rapidly as the temperature rises, in accordance with the law of densities.

Photographic Action Inside of Discharge Tubes. Battelli. *Phil. Mag.*, February.—A short article in which he describes results of experiments with the photographic action and electrical dispersion inside of the tubes; the photographic impressions were always strongest on the side toward the cathode and only very slight on the other faces; he eliminated the phosphorescent action of the covering of the plates; he concludes that the rays which produce photographic action inside of the tube are, at least in part, not deflected by the magnet; amongst those rays which are deflected by the magnet there are some endowed with photographic action. He also investigated how the photographic action inside of the tube varies with the variation of the rarefaction; the action increases rapidly with the rarefaction, and then from 0.01 mm onwards much more slowly. He concludes that Rontgen rays are already existing inside of the tube, together with the Lenard rays; the one kind passes through the walls of the tube better than the other; only one kind would pass out if the tube were made of thick glass.

Internal Rays. Oudin and Korda. Lond. *Elec.*, Feb. 12.—A short reply to the discussion with Thompson (see *Digest* last week). They explain their difference and claim to have misunderstood Thompson; they think the name internal rays superfluous for the cathode ray reflected by the anti-cathode and known long before Rontgen's discovery.

Cathode and Röntgen Rays. Wilkins. Lond. *Elec.*, Feb. 12.—A communication in which he suggests that cathode rays are electrified particles or polarized atoms of the attenuated molecule of atmospheric matter, which is consequence of its newly acquired condition is free to form other combinations with other atoms.

Thermo-Electric Currents in Molten Metals. Backhmetieff and Stambolieff. *Proc. Lond. Phys. Soc.*, January; abstracted from the Russian journal of the Physical and Chemical Society, 27 pp. 1 and 64, 1895.—The cooling of a metal or alloy always produces, in a pair of electrodes plunged into the mass, a current which varies irregularly and is probably due to different causes; it is independent of the nature of the electrodes and is much too great to be attributed to thermo-electric causes only; they think that crystallization and variation of volume are the principal causes; a few of the results are given in the abstract. They heated part of a conductor by means of an electric current and observed the currents generated during cooling, the direction of which was almost without exception inverse to that of the current producing the heat.

Influence of Tensional and Compressive Stresses on the Thermo-Electric and Magnetic Property of Metals. Meyer. *Wied. Ann*, Vol. 59, No. 9; abstracted briefly in the *Jour. Inst. Elec. Eng.*, January—The results regarding the thermo-electric properties are given in the abstract. (See also *Digest* Feb. 13.)

Dust Figures. Archer. *El'ty*, Feb. 17.—A brief description of an experiment in which one terminal of an induction coil was connected to a metallic plate over which was placed an insulating material on which is a pile of pulverized charcoal, in the centre of which is inserted the wire connected to the other terminal; the carbon will begin to move out radially assuming a permanent position, forming a series of irregular circles. The article is accompanied by illustrations of these figures made by others, showing the difference between the figures produced by a negative and positive terminal; when the anode was made in the form of a ring, some of the carbon was drawn up through the ring and distributed on the paper outside, arranging itself finally in the form of a dense ring; when the carbon was placed between two condenser plates it formed miniature whirlwinds.

Physics of X-Rays. Houston and Kennelly. *Elec. Jour.*, Feb. 15.—A reprint of a paper read in October, in which they consider briefly the production of X-rays and the various theories which have been advanced to account for their properties; the burden of evidence is said to be in favor of their being very high frequency waves of ordinary light.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity in Chemical and Metallurgical Industries. Kershaw. Lond. *Elec.*, Feb. 12; a continuation of his serial (see *Digest* last week)—He discusses the production of alkalies and chlorine. There are no trustworthy figures showing the actual production; in the present year it may perhaps amount to 100,000 tons of soda and bleach, in Europe. In a table he gives the names and other available details of the companies, with the estimated annual output of some of them. He divides the pro-

cesses under those in which a diaphragm is used and those in which it is not used, and discusses each briefly; the most successful of the diaphragm process is the one at Frankford and at Bitterfeld, but the composition of the diaphragm is kept a secret; the Hargreaves-Bird is thought to be the most promising of the English inventions; the Castner-Kellner non-diaphragm process is the one which is developing industrially the most quickly; the Vautin process, in which fused salt is used, may possibly become a dangerous rival. In the discussion of the efficiency he complains of the lack of data and gives the figures of only the three processes used in England; for the Hargreaves-Bird it is 54 per cent.; for the Castner-Kellner, 52.3, and for the Richardson & Holland from 37 to 56 per cent.; there is therefore much room for improvement; in these estimates the electrical energy represents about 30 per cent. of the total cost; in a short table he gives the cost of production in four cases, showing great divergencies; for one ton of 70 per cent. caustic and 2.1 tons of 35 per cent. bleach, the cost varies from about $42 to about double that amount; the actual cost in a long period will probably give a figure between these two extremes; a keen competition between the electric and the usual process is predicted.

Aluminum Amalgam. BIERNACKI. *Wied. Ann.*, page 664; noticed briefly in the *Elek. Zeit.*, Feb. 11.—An aluminum wire is readily amalgamated if it be connected to one pole of a battery of a few volts, the other pole of which is connected to mercury; by dipping the wire into the mercury several times, sparks will be produced which will cause amalgamation. Such a wire in moist air is quickly covered with a large white mass of pure clay; the action is so apparent that it may be shown as a lecture experiment, illustrating an exothermic reaction; in very dry air the wire remains unaltered and may be kept for any length of time; in water, especially when warm, there is a strong evolution of hydrogen; placed in alcohol containing water, the alcohol will be de-hydrated.

Carbon for Electrolytic Purposes. LESSING. Lond. *Elec.*, Feb. 12.—A translation of th article abstracted in the *Digest*, Feb. 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Insulation, Measurements of Three Wire Circuits. TRAVAILLEUR. *L'Eclairage Elec.*, Feb. 6.—A mathematical article, in which he discusses the method suggested by Place, and another by Houston and Kennelly, for measuring the insulation in three wire circuits while in use. He shows that Place's method involves an error; an approximation is first made on the supposition that the current in the ampere meter is zero, after which the current in this instrument is measured. The Houston and Kennelly method is exact in theory, but the conclusions regarding its application, he thinks, are inapplicable in practice; they consider that the combined resistance of the three wires is absolutely constant during the duration of the test; but it is certain that this resistance varies; thus leading to incorrect results; at all events, this has been the experience in the daily tests at the station in Brussels. In this station he has used for 18 months a similar method, due to Rousseau, and found that to get even only approximately correct values for the resistance, it is necessary to vary the voltage about 20 per cent.; this method he discusses; contrary to the statement of Houston and Kennelly, the method is absolutely inapplicable when the neutral wire is connected to the earth, as the possible error then approaches infinity. He thinks it better to limit oneself to determining the minimum values of the three insulating resistances, as this simplifies the problem and the calculation very greatly; the determinations are made much more correctly; the test can be made while the wires are in use, and the indications are sufficient for controlling the system. For obtaining these values the total resistance is measured by such a method as that of Houston and Kennelly, then knowing the voltage and this resistance, the problem is solved. An apparatus has been constructed for determining the resistance and the difference of potential automatically during the whole day, thus the records give all that is necessary for calculating the minimum resistance. The method also enables one to determine the maximum watts lost through the earth.

Self-Induction Standards. WIEN. *L'Eclairage Elec.*, Feb. 6; translated from the *Wied. Ann.*, 553.—He describes how these standard coils are made and how they are then calibrated. They are calculated according to the formulas of Maxwell for giving the maximum self-induction; the spool is made of serpentine; it is very unsatisfactory to attempt to calculate them accurately; it being preferable to adjust the value experimentally; to determine their absolute value he uses a Wheatstone bridge, the application of which is described in detail.

Thermic Volt and Ampere Meters. DUJON. *L'Eclairage Elec* Feb. 6—A discussion of hot wire instruments in general and more particularly of those in which the heated conductor is made of two metals of different coefficients of expansion; he discusses the theory of these and suggests an ampere meter based on this principle, for measuring large currents; the conditions are discussed mathematically; he shows how to calculate the best conditions for the maximum deflection and calls attention to the importance of considering the permanent deformation in such instruments; in conclusion he describes with the aid of a sketch, an instrument of this kind; to eliminate the effect of variations of the surrounding air, two like strips are made to oppose each other in their action, on the pointer, but only one of these is heated by the current; the advantages of such an instrument are simplicity, the absence of magnetic action and of self-induction, and they are equally applicable to alternating and direct currents.

Meters. ARMAGNET. *L'Eclairage Elec.*, Feb. 6.—A continuation of his long serial; in the present portion he gives an illustrated description and discussion of several forms of meters.

Balance Galvanometer.—Elek. Zeit., Jan. 28.—A brief illustrated description of the Mueller system. A large bar magnet rests in a horizontal position on knife edges, around which it turns slightly; a graduated scale, on which riders can be placed, is attached to it; at the ends of the scale are pointers by means of which the zero position may be determined; a glycerine damper prevents repeated oscillations; the coil, which is oblong and slightly larger than the magnet, is held on fixed supports, so that the magnet is free to move in its interior; the current deflects the magnet with its beam and by means of the riders, of which there are a number having different weights, the deflection is brought to zero. It is said that currents up to 200 amperes may be measured directly with an accuracy of 0.1 ampere; the coil can readily be replaced by one having many turns of fine wire to be used for voltage measurements; the instrument is said to be particularly applicable to the uses of the electro-chemists.

Watt and the Measurement of Power. PREECE. Lond. *Elec.* and *Elec. Rev.*, Feb. 12.—A reprint of a recent lecture, in which he discusses the subject and history of units of power, and favors the abandonment of the term hp and the substitution therefor of the term kilowatt.

Electrometer for Small Potentials. PEROT and FABRY. Lond. *Elec.*, Feb. 12.—A translation in abstract of the French Academy paper noticed in the *Digest* last week.

Locating Swinging Crosses and Swinging Grounds. GINGRICH. *Teleg. Age*, Feb. 16.—A brief description of a simple method due to Diehl which has been in use for a number of years; it is a modification of the Varley loop method. Assume that the wires swing together although the contact is only momentary; connect one of them to a good wire at the first office beyond the cross, and assume that the loop then formed measures 200 ohms; one pole of the measuring battery is put to ground and the other to the bridge resistances, the loop forming the other two branches; the other swinging wire is put to one pole of a comparatively large battery, the other pole of which is grounded, a relay being in this circuit; the galvanometer circuit of the bridge is then closed, and there is a deflection when the wires swing together, simultaneously with the click of the relay; the resistance of one of the arms of the bridge is then changed until the needle remains unaffected during a contact, although the click of the relay continues; the resistance of the line wire to the cross is then calculated from the arms of the bridge, the cross representing the other battery terminal. To locate a swinging ground, the same measurements are made, the swinging wire being looped with a good return wire at the first office beyond the swing.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Development of Telephony. WEST. *Elek. Zeit.*, Feb. 4.—The first part of a reprint of a long paper; it is of a general character and is largely of local interest only. He points out the influence of the telephone on the industrial and intellectual development of nations, and discusses a general plant for a complete telephone system covering the whole of Grmany, enabling each subscriber to spak with each of the others; the country should for this purpose be divided into districts, say about 25 for the whole of Germany, with the 25 larger cities as their centres; these centres should then be connected with trunk lines; the idea of such a system should be borne in mind in designing the present systems, and it is, therefore, best to have only one central station for each city. He prepared an approximate estimate of the cost of such a general system for Germany, assuming 25 separate districts, and discusses some of the difficulties and limitations which would arise; among them the system of long-distance transmission and the injurious effects of railway currents.

Telephone Charges—Elek. Zeit., Feb. 11.—A long editorial discussing the recent intention of the German Government to reduce the charge for telephone service from $37.50 to $25 per year for cities of a population of less than 10,000; while most of it is only of local interest, there are some points of more general interest. It was shown that such a decrease would require a certain increase in the number of subscribers to pay for the loss in the income, and that the first cost for increasing the plant would be very great; every attempt to reduce the charge, would thus lead to a great expense. This is also discussed from another standpoint, in which the attempt is made to find the percentage which the telephone charge bears to the income of the user, and from this to find what the probable increase would be if the charge were reduced; the reduction from $37.50 to $25 in cities of less than 100,000 inhabitants would mean an increase of 80,000 to 85,000 new subscribers, and the capital required to enlarge the service would be from ten to eleven million dollars; this applies to the whole of Germany; as it is questionable whether this money could be provided, it is concluded that the charge at present is the best that can be arrived at; if, however, the money could be provided, then the reduction would be justified. A conversation in Berlin costs 0.83 cent. and in Norway 1 cent; in 1894 it was 1 cent for Germany, 1.07 for Sweden, 1.31 for Austria, 1.72 for Belgium, and 3.68 for Switzerland; in Leipsic it is said to be 0.55. The need of a practical telephone meter or counter was pointed out by the Government; it should be simple, cheap and operate reliably; it must not require any great change in the present system of connections. It is suggested as a better way to arrive at the desired end, to gradually increase the present limits for each subscriber; when these limits are increased there will be less claim for a reduction in the charge; such extensions cannot be made suddenly, but should be introduced gradually.

Communication Between Coast and Light Ships. SMITH. Lond. *Elec. Rev.*, Feb. 12.—A long communication, chiefly historical, describing the experiments of the late Willoughby Smith, in order to show that the experiments of Blake in conjunction with the U. S. Light House Board were not original.

Telephone Trunk Lines. PIERART. Lond. *Elec. Rev.*, Feb. 12.—A continuation of the discussion (in French) with Gavey concerning the question why the shunted condenser which annuls the action of self-induction, does not interfere with the telephonic communication by making the telegraphic signals audible in the telephone. He states that the shunted condenser was added to the circuit solely for the benefit

of the telegraphic signals; it has nothing in common with the Van Rysselberghe system; the shunted condenser is in use on a circuit containing the Hughes apparatus, its object being to prevent the production of "kicks."

Storage Battery for Telegraphy. Gardanier. *Teleg. Age*, Feb. 16.—A brief description of the new plant at New Orleans, with an illustration of the switchboard. The plant consists of 843 cells, replacing 7000 gravity cells; the battery is arranged in 16 groups, of 42 cells each; one-half of the entire battery is connected to the charging mains, while the other half is in use; the plant was installed in July and gives perfect satisfaction. This is the third large storage battery plant installed by the Western Union Company, the first one being in Atlanta and the second at Washington; besides this, there are 18 smaller offices equipped with 2600 cells; the expense of maintenance over primary batteries is so greatly reduced that it is likely that other offices having a large number of gravity cells will be similarly equipped.

Thompson's Ocean Cable.—Elec. Jour., Feb. 15.—A reprint of the recent discussion in Lond. *Elec. Rev.* noticed in the *Digest*, Feb. 13.

Telephone Toll Lines. De Land. *Elec. Eng'ing*, March.—A short article, including maps of the toll lines around Minneapolis, Galveston and Chicago; he discusses toll lines in general, showing that when properly constructed they are very expensive and rarely prove productive investments, the patrons of such lines being few in number; the average cost of building the standard toll lines by the Bell Company ranges from $197 to $329 per mile.

Telephone Companies.—Elec. Eng'ing, March.—A brief report of the annual expenses of the Central Union Company in Chicago, and of the Fort Wayne Company; there is also an article on the evils of unrestricted competition.

Modern Telephone Plant. DeLand. *Elec. Eng'ing*, March.—A brief illustrated description of the plant at St. Joseph, Mo., which is claimed to be one of the most complete and best appointed telephone exchanges in the world.

Telephone Transmitters. Wietlisbach. *Elec. Eng'ing*, March. A continuation of his long serial, the present portion giving illustrated descriptions of various forms of microphones.

Telephony. Weitlisbach. *Elec. Eng'ing*, January.—The article under this setting in the *Digest*, Feb. 6, was incorrectly credited to the Lond. *Elec. Eng.*

MISCELLANEOUS.

Heating and Cooking Utensils. L'Ind. Elec., Feb. 10.—An illustrated description of a number of different implements and utensils made in Paris and recently exhibited at a meeting of the International Society.

Paris Exposition of 1900.—*L'Ind. Elec.*, Feb. 10—A list of the subjects pertaining to the group covering electricity, which is divided into five

Aluminum Patent Decision.—Eng. and Min. Jour., Feb. 20.—A statement that a decision has just been rendered in the long pending suit over the ownership of the Bradly patents, the title of which is now decided to be held by the Cowles Company; litigation between this company and the Pittsburg Reduction Company, it is expected, will now be renewed.

Magnetic Separation of Non-Magnetic Materials. Raymond. *Eng. & Min. Jour.*, Feb. 20.—A brief abstract of a recent paper read at the Chicago meeting in the American Institute of Mining Engineers. He discusses the gap between the strongly and weakly para-magnetic substances and refers to the work of Pluecker, published in 1848, in which are given the results of careful experiments; the magnetic attractability of a number of iron ores and compounds, as compared with that of iron, are given, but these results do not agree in all respects with those obtained by later experimenters.

Manufacturing Co.—Elec. Eng., Feb. 17.—A long, profusely illustrated description of the Wagner Electric Mfg. Company, at St. Louis, including illustrations of a number of its products.

New Book.

Power Distribution for Electric Railroads. By Louis Bell, Ph. D. Street Railway Publishing Company, New York. Cloth, octavo, 268 pages, 139 illustrations and diagrams. Price, $2.50.

The distribution of electric power to the various cars in operation on a railway system presents many practical difficulties which are never thought of by those not actively interested in the electric railway industry. In this book Dr. Bell has discussed these difficulties in his usual lucid and interesting manner. The numerous important problems connected with the design of a system of conductors for electric railways are fully considered in the light of the existing conditions and a satisfactory solution of the problem is reached in each case.

The scope of the work will probably be best shown by a brief mention of the contents of each chapter.

Chapter I. deals with the fundamental principles of the subject; the conditions to be met with in practice, etc. The variations in the load, both in magnitude and location, are clearly and practically considered and simple fundamental formulas for the design of working conductors and feeders for any system are developed.

The most desirable location for the power house also receives attention. The return circuit is considered in Chapter II.; track, joints, bonds, etc., all receive the comprehensive treatment which their importance warrants. Chapter III. is concerned with direct-feeding systems while special methods of distribution are discussed in Chapter IV.; the booster and the Edison three-wire systems are fully explained; substations and the transmission of power from them receive careful treatment in Chapters V. and VI.; transmission by alternating current and the use of rotary transformers receive due attention; Chapter VII. deals with the important subject of alternating motors for railway work, including a discussion of the work which has been accomplished in this direction, and the great advantage of this type of apparatus for the purpose. Interurban and cross-country work is the subject of Chapter VIII., while fast and heavy railway service are considered in the final chapter, No. IX.

This book contains valuable information, which every one who is engaged in designing electric railway systems or extensions should possess, while it cannot fail to be of great interest to all engineers, capitalists, and others who are in any way interested in the practical operation of such lines.

Easy Inspection of Large Generators.

Where plenty of floor space is available the method described and illustrated herewith is one of the most convenient and economical ever devised for the purpose of facilitating the inspection of large generators. It is the invention of Prof. Sidney H. Short, Cleveland, Ohio, and by its use repairs can be accomplished with much ease, and with a consequent saving of time. The arrangement is as simple as it is practical, and consists of extending the base of the dynamo, and the shaft proportionately, so that the field frame may be unbolted and slid away from the armature in a direction parallel to the shaft. This single motion permits the inspection of the entire armature and field magnet, and, at

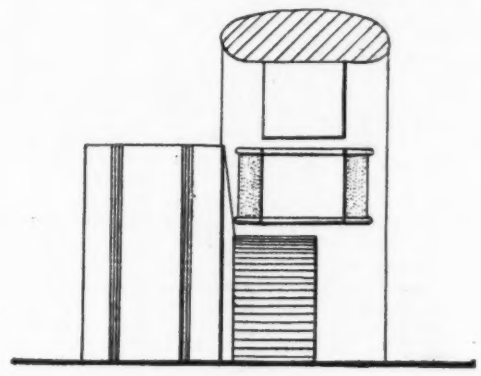


Fig. 1.

the same time, affords greater facility for repairs. The removal of the field frame is thus accomplished without the use of a traveling crane, or similar device. Two workmen, with a wrench and a pair of crowbars, can do the work in a few moments. The ordinary way of removing field frames, as is well known, is to lift the upper half of the field magnet, and if the lower half happens to be at fault it will be necessary to

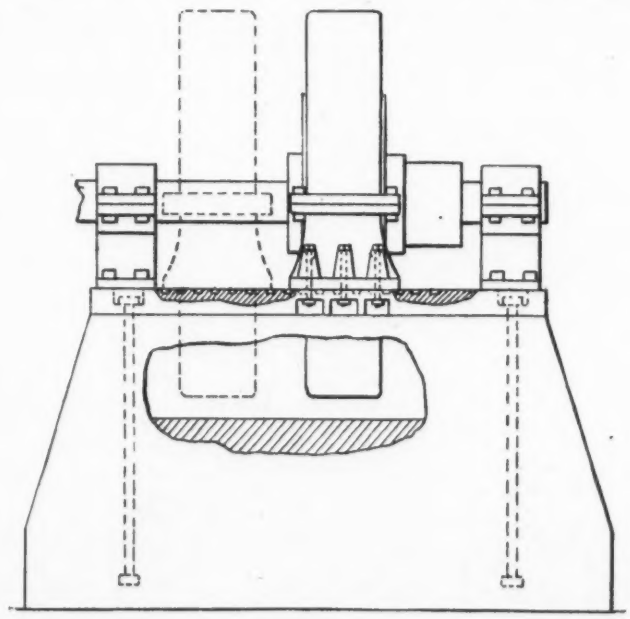


Fig. 2.

remove the armature also. With direct-connected armatures this is often exceedingly troublesome. The chance of damaging either the armature or field magnet is great, since it is often difficult to find a suitable place to store these parts while repairs are being made, and the moving of such heavy insulated members is always, at best, a perilous undertaking. With this device the repairs can be accomplished,

and none of the parts of the machine need lay about the station exposed to danger.

By referring to the accompanying illustrations the principle and arrangement of the device will be readily understood. The base of the dynamo is suitably finished by machine tools, so as to reduce friction in sliding the field casting over it, and suitable recesses are cast in the bed itself to facilitate the use of the crowbar.

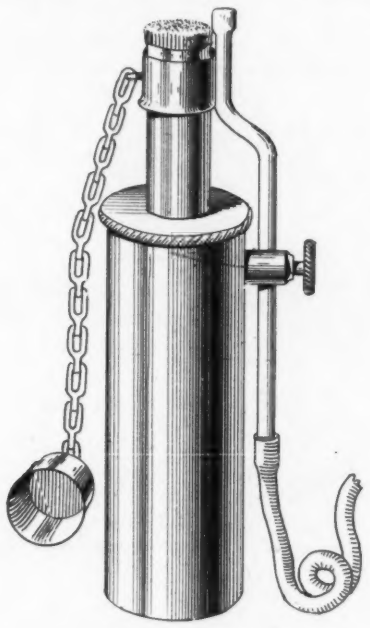
When floor space is limited the field magnet is arranged to slide over the commutator, as shown in Fig. 1. In this position the magnet spool can be easily removed, as indicated.

If it is desired to manufacture dynamos which slide in the manner indicated in Fig. 2, it is simply necessary to dowel in a piece on the base pattern, that can be removed if necessary for casting other bases.

Alcohol Torch.

The accompanying illustration represents a novel and convenient alcohol torch which is being placed upon the market by Vallee Bros. & Co., 625 Arch Street, Philadelphia, Pa.

The torch itself, while being of a size most convenient for use, has



ALCOHOL TORCH.

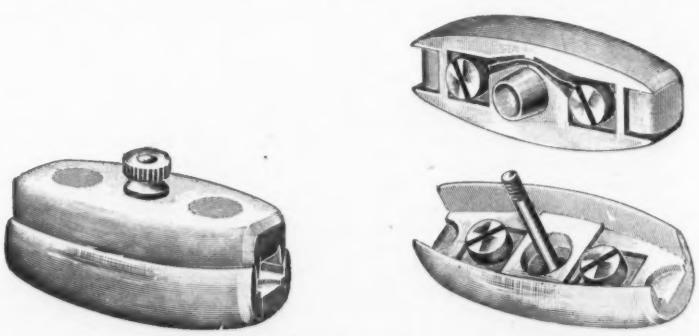
a feature which will be appreciated by all. The blow-pipe, instead of being permanently fixed to the side, as is the case in other torches, is so made that it can be readily adjusted to the wick, thus giving the very best results.

This torch is called the "Victor," and is 6¼ inches high by 1½ inches in diameter. Its small size will commend it to all who use torches.

Bug Cutout.

Among the numerous specialties placed upon the market recently is the Bryant bug cutout, manufactured by the Bryant Electric Company, Bridgeport, Conn.

The accompanying illustration represents the device in detail, both open and closed. The advantages claimed for it are the impossibility of a short circuit; only one nut to remove; the fuse is placed in the cover, instead of the base, and it is not necessary to remove the connecting



BUG CUTOUT.

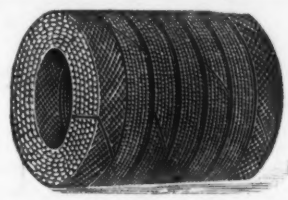
wires to replace a fuse. These advantages would seem to commend it to the trade as a very useful device.

The illustrations, it should be stated, represent the bug in its actual size, and its construction will be readily understood by reference to the same.

"Duo" Packing.

Valve and piston-rod packings that are suitable for packing glands of engines working at a pressure under 100 pounds to the square inch fail to meet the requirements of the modern steam engine using steam from 125 to 150 pounds, the deficiency being due mainly to the much higher temperature and the increased pressure of the steam.

The Garlock Packing Company, Palmyra, N. Y., fully realizing the importance of meeting all the requirements for a high-pressure pack-



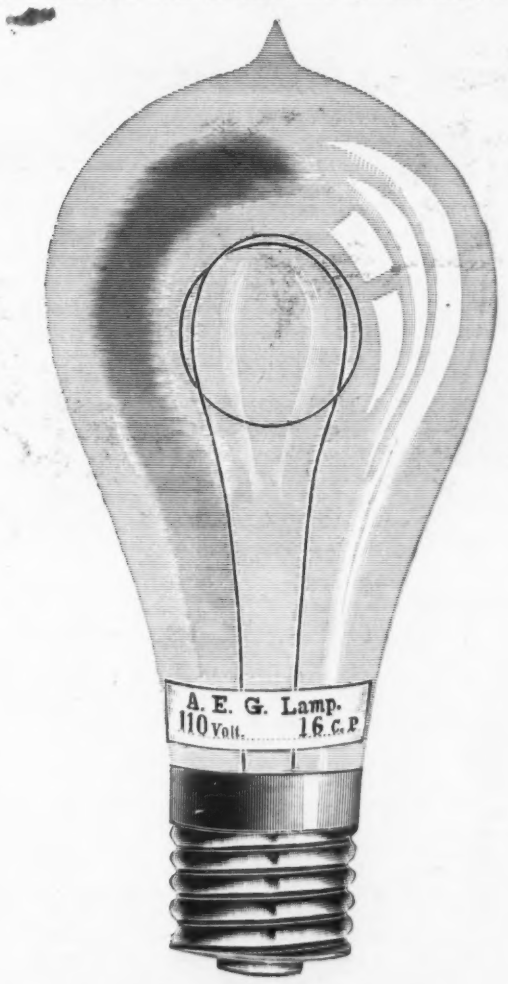
"DUO" PACKING.

ing, have, for a number of years, carried on some experiments, resulting in the product now being placed on the market called the Garlock "Duo" Packing.

This packing is particularly adapted for high pressure steam and hot water purposes, and works equally well where a low pressure is used. It is guaranteed to give perfect satisfaction under all conditions and in all places where a high pressure or hot water packing is required.

The A. E. G. Incandescent Lamp.

Believing that there is always a ready market for goods of superior merit, the Allgemeine Electricitats Gesellschaft, Berlin, Germany, has made arrangements to introduce its lamps in the United States, and has appointed Messrs. Machado & Roller, 203 Broadway, New York City, sole agents for America. Arrangements have been made by this concern to constantly carry a stock of 50,000 lamps of various candle-power and bases. The A. E. G. lamps are particularly graceful in general outline, as will be seen from the accompanying cut. The filament is of superior quality prepared by a secret process. The base contacts are made of spun brass, insulated with porcelain, and an exceedingly small amount



THE A. E. G. LAMP.

of a specially prepared plaster is used to cement the bulb to the base. Great care is exercised throughout the various stages of manufacture, tests being made at each step in the construction of the lamp, and the result, it is claimed, is that the lamps have a very long average life with a very high average efficiency.

These lamps are guaranteed for 800 hours.

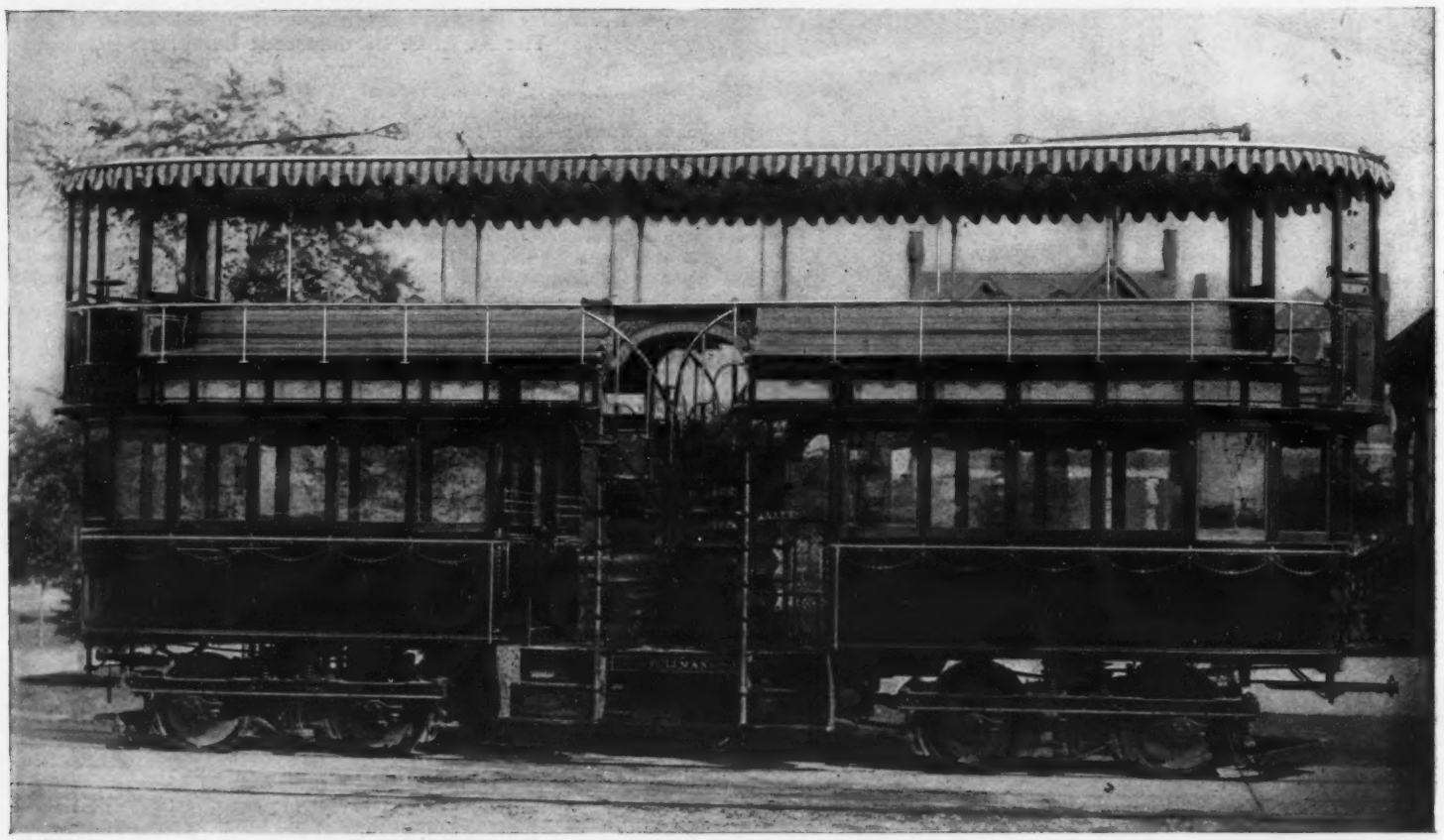
It will interest our readers to know that the A. E. G. Company was the pioneer lamp factory in Europe, having started in 1883, and that it has from the start kept at the head of the procession, and has at present a capacity of 50,000 lamps per day. This Company's trade-mark is well-known throughout Europe and the Orient, and has become, as it were, a hall-mark of quality, guaranteeing to a customer that goods so marked represent the very highest attainment of the art. As a result of this reputation, based primarily upon its lamps, the A. E. G. Company has built up a most extensive business, and its factory to-day is said to be the largest in the world.

Centre Vestibule Car.

The car represented in the accompanying illustration is, in its design, a radical departure from the ordinary type of street car, and combines comfort, convenience and safety for passengers, with all the requisites which make it a commercial success.

The most prominent feature of design is the central vestibule or passage, with divided central entrances. The seating compartments occupy the ends of the car, and communicate with the vestibule and stairways to the roof seats.

On the roof, at each end, is a cab for the motorman, and accessible through the vestibule and stairways. The car has no end platforms, entrance and exit to the car being effected through the vestibule entrances,



Centre Vestibule Double-Deck Car for Street Railways.

which design is claimed to be safer and more convenient than the ordinary way.

This type of car possesses some noteworthy advantages. Drafts through the car are avoided, and by means of automatic devices pleasant and healthful circulation of air is obtained.

The upper-seat feature is a very attractive one, affording, as it does, every facility for enjoying the sights of city streets and delights of the country scenery.

The question of cost, of course, is an important one with the railway companies. It is claimed that the saving in first cost will amount to over 50 per cent. per passenger on the car equipment of the road, the calculation being based upon the relative cost and carrying capacities of the different types of cars. The carrying capacity of one of these cars is 80 passengers. Besides this item of economy, it is claimed that the electrical equipment for a centre vestibule car, seating 80 passengers, will cost at least one-third less than for two ordinary cars seating only 72 passengers. The percentage of earning capacity of one of these cars is said to be greater than that of two ordinary cars, and the vestibule car is so much lighter per passenger seated as to effect a large saving in power.

Old equipment can be remodelled and altered into upper-seat centre vestibule cars, at a comparatively low cost.

This car is the invention of Mr. Charles L. Pullman, and is made by the C. L. Pullman's Centre Vestibule Car Company, Suite 806, Fisher Building, Chicago, Ill.

The Manufacture of Tubing.

The use of iron or steel pipes for conduits for electrical conductors has become so extensive in these latter days that a description of the principal concern manufacturing these goods will be of interest at this time.

The National Tube Works Company, McKeesport, Pa., is said to have the largest establishment of its kind in the world. The plant is located just below the junction of the Youghiogheny and Monongahela Rivers, in the State of Pennsylvania, directly on the bank of the latter stream and occupying over 100 acres of ground.

The Company was started in Boston in 1865, and in 1872 its works in McKeesport were put into operation. The works of the Company at the present time extend for a mile along the bank of the Monongahela River, and from nine to ten thousand men are employed in all departments. The annual capacity of the National Tube Works Company of tubular goods is over 250,000 tons, and its product goes to all parts of the world, including England, which has hitherto been considered the home of the iron and steel industry.

A faint idea of the magnitude of the operations of this company may be obtained from the fact that over 900,000 tons of coal are consumed at the plant every year, requiring for its delivery coal cars which, placed end to end, would cover fully a mile, this great number of cars being admitted to the yards every day in the year.

The product of the Company includes gas, hot water and steam pipe, pipes for conduits for telegraph, telephone and electric light wires, underground and interior work, street railway conduits, etc., besides water-works mains and pipes of every description and for every use.

To obtain the best results in the production of its goods the National Tube Works Company in 1892 built a complete steel plant near its blast furnaces, thus placing itself in a position to control every stage of the process of manufacture from the raw iron ore to the finished tube or pipe. Every particle of iron or steel which is employed in this establishment receives the most careful and systematic inspection, to the end that the best obtainable results may be had and the best satisfaction to patrons guaranteed.

The prime requisite of the special mild steel made by the National Tube Works Company is that it shall produce pipe which will weld so that the weld will be at least as strong as the body of the pipe itself and which will take a perfect thread and possess flanging qualities as good as those of the highest quality of Swedish charcoal iron. These results are obtained in the pipe mill, where are located several welding furnaces, and the necessary cutting and threading machines, besides testing benches, etc.

The skelp (thin strips of rolled steel varying in width, length and thickness) after having been beveled on its edges is pushed into a welding furnace and subjected to a welding heat. It is then passed over a mandrel and through a pair of welding rolls, which press down the lap and form the mass of metal into an even cylindrical form. The pipe, then in its rough state, is passed through sizing rolls and afterwards straightened in dies controlled by hydraulic power. The rough

ends are then cut off, threads cut, a coupling is screwed on and the tubes are inspected, after which they are ready for the market.

Over 1000 different sizes of tube are produced at these mills, ranging in diameters from the one-eighth inch gas pipe to the 24-inch water, gas or oil main. The aggregate horse-power required in all the departments of this vast industry is 20,000, and the business requires the constant use of 12 locomotives and 500 cars in the transportation of material between the different departments during the process of manufacture.

The National Tube Works Company maintains sales offices at New York, Pittsburg, Chicago, Boston and St. Louis, and is now establishing an office at London, England, where its foreign trade will be looked after.

New Incandescent Arc Lamp.

On Saturday night last a new type of incandescent arc lamp was brought to public notice for the first time, at 713 Broadway, New York City. This lamp is the invention of Mr. G. R. MacIntire, and is manufactured by the International Arc Lamp Company, Mercer and Houston Streets, New York. In design and construction it is a radical departure from anything in its line hitherto produced, and seems to fill a demand for a lamp adaptable to domestic and public interior lighting, and lighting in general, that has long existed, but which has, so far, remained unsatisfied.

The most remarkable and valuable feature of this new lamp is its small size, and the facility with which it can be adapted to produce illuminating and decorative effects.

The lamps displayed at 713 Broadway depended from the ceiling, and were six in number. The total length of each lamp is 16 inches, the inclosed arc globe measuring 5½ inches deep and 3½ inches in diameter. The lamps were provided with porcelain shades, from the periphery of which hung glass prism pendants, greatly heightening the illuminating effects. The inclosed bulb of each lamp was surrounded by a closely fitting tinted shade, attached to the bottom of the bulb, with its bell end turned upward. The effect of this was to give a very delicate tint and soft character to the light, which was of remarkable steadiness.

One of the most striking features of the light was the entire absence of shadows and its perfect diffusion, and in connection with the delicately tinted decorations of the room the illumination effects were extremely pleasing.

The International Arc Lamp Company makes its new lamp in a large variety of designs, ranging from the prosaic street lamp to the most exquisitely wrought lamp for elaborately decorated interiors. The ordinary street lamp is known as the "Greater New York Lamp," and burns with a white, steady light, and with the absence of shadows stands in marked contrast with the ordinary short-life lamps in common use.

The Column lamps, for newel posts or entrances to buildings, halls, etc., are made in a great variety of designs. The feeding mechanism is located in the base of the column, where it is most easily accessible.

The marine lamp is made in three sizes, to burn 150 hours, 100 hours and 50 hours. The length of the 150-hour lamp is 16 inches; of the 100-hour lamp 10 inches, and of the 50-hour, 9 inches. The latter takes two amperes of current.

The Company is also making a very excellent focusing lamp, that possesses many novel features in construction and design.

The feeding mechanism of these lamps is of the simplest character, not a spring of any sort being used in the movement. The ease of trimming is also a very valuable feature.

The pendant lamps take 5 amperes of current, at 80 volts. These new lamps are made for direct and alternating current, and seem to have the promise of becoming a strong rival for popular favor.

Side Crank Medium Speed Engine.

The accompanying illustration represents the side crank medium speed engine built by the Ball Engine Company, Erie, Pa. This type of engine has been designed to meet the extremely severe conditions of electric railway service, so that all parts are unusually liberal in material and every known refinement in adjustment and manipulation has been incorporated.

The bed is symmetrical, and contemplates provision for every strain that may be put upon the engine in service, and is an exceptionally excellent example of mechanical designing and rigidity. Towards the upper end the bed becomes a round circular column, having on two sides of the finished surface the crosshead guide surfaces, which are bored coincident with the boring and facing for the reception of the cylinders. The two sides are pierced with elliptical openings, making easy access to the crosshead or upper end of the connecting rod.

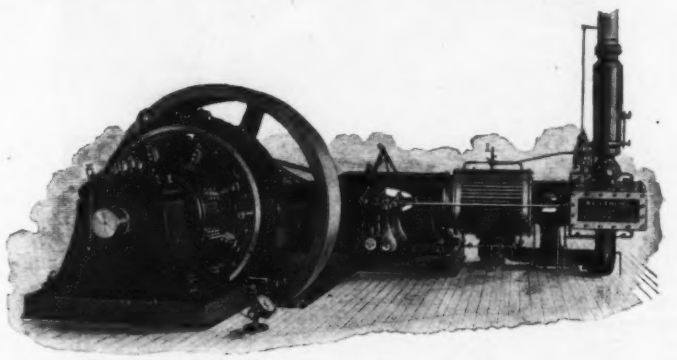
The crosshead is of the double-plate pocket type, used by many makers of Corliss engines, and is provided with taper shoes to compensate for any wear that may occur against the guides, the shoes being of cast iron and running surfaces spotted with genuine babbit metal, the area of which is very liberal.

The introduction of the shaft into the engine is accomplished by arranging the shaft boxes in a large jaw, cutting into the bed deep enough to bring the centre of the shaft in a plane with the centre line of the engine, finished spots being provided to meet corresponding finished surfaces upon the cast iron boxes. These boxes consist of one bottom, two quarter and one top box, each of which is provided with removable babbit metal shells, upon which the journal bears. The adjustment of these boxes is accomplished by means of set screws, one of which operates (either in or out), a wedge, which fits between the lower side of the jaw in the bed and bottom of the lower box, two others operating wedges on the sides for the side boxes, and two which reach the top box, thereby giving for all positions of adjustment of the quarter boxes, a full bearing for the shaft in the lower box.

The crank shaft is one solid piece of 40-carbon open-hearth forged steel from end to end, and ground to a perfectly round, smooth running surface. Surrounding the crank-throw is a disc, carrying a sufficient amount of counter-weight to give a running balance to the crank and to the reciprocating parts, so there is no vibration to be communicated to the frame and other working parts of the engine.

The connecting rod is of forged steel, hammered down from a solid bloom, with both ends cut out to receive the crank and crosshead boxes. The adjustment of boxes on both ends of the rod is by means of wedges operated by T-pointed set-screws, placed in the top of the rod, which move the wedges up or down, for adjustment, and as the movement of the wedges is in the same direction, the length of the rod is not changed, nor is the position of the piston altered. The adjustments can readily be made by hand with a great degree of accuracy.

The high-pressure valve is of the double-face telescopic type, receiving the boiler pressure on the inside, there being a sufficient amount of unbalanced area on the faces so that the pressure of the steam on the



MEDIUM SPEED ENGINE.

inside forces the two faces apart, causing each to rub against the seat with a sufficient force, it is claimed, to keep the surfaces polished and steam tight through the entire life of the engine.

The low-pressure valve is of the common letter D type, with improved construction and proportion. It is provided with a round relief area upon its back, operating against the chest cover, thus having a large well-proportioned valve that runs with the greatest ease, yet follows up its wear without attention from the outside.

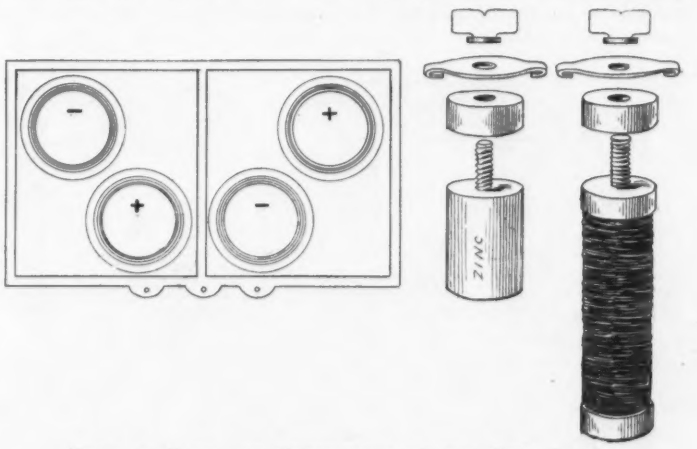
The outboard bearing has the same form of boxes and adjustments as the main bearing, and as a very liberal amount of metal is employed, makes a strong and substantial support to the outer end of the shaft. The material used in the piston rods, valve stems, rocker shafts, and crank pins is the best crucible steel, which, on account of its hardness and strength, gives the greatest possible amount of wear.

The governor is quiet in operation, quick in action, perfect in regulation, and is especially adapted to the sudden shocks of railway service.

Electric Bicycle Lamps at the New York Cycle Show.

Probably one of the most noticeable features of the recent New York Cycle Show were the numerous displays of bicycle lamps.

The production of the ideal bicycle lamp, which should be small, light, easily handled, capable of long life, with a single, easily-procurable charge, and cheap, seems to be yet an unsolved problem in bicycledom. Oil lamps were shown in the most lavish profusion. It seemed, how-



PLAN OF CASE AND ELECTRODES OF THE BELL LAMP.

ever, that all such lamps stood out with most glaring deficiencies, when compared with those in which electricity, or one of its most prominent recent products, calcium carbide, were used. Three strictly electrical, and one acetylene gas, bicycle lamps were shown, and from all apparent indications, at least some of these may prove strong competitors to the oil lamps.

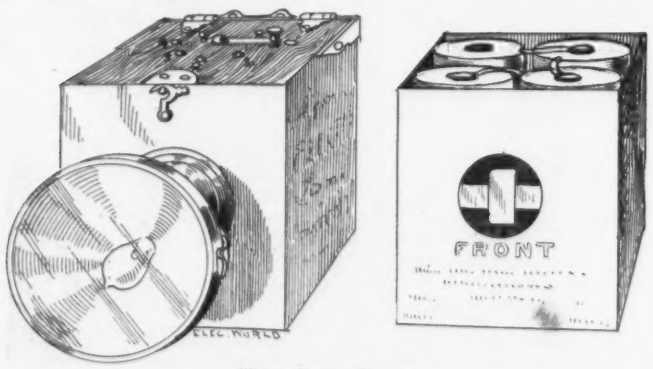
The Bell Electric Company, 136 Liberty Street, New York City, showed

an electric bicycle lamp possessing a great number of very ingenious features. This lamp consists of a rectangular rubber receptacle, or case, divided into two parts, each of which forms a separate battery cell. In front of the rubber case is placed a small 2-cp lamp, behind which is a reflector, and covered by bull's-eye glass. The elements of the battery consist of a short, zinc plug, which forms the negative electrode and a pencil, made up of some specially prepared compounded material, forming the positive electrode. Both of these

Bell Lamp Complete.

electrodes are cylindrical in shape, and are inserted into their respective chambers through apertures in the top of the outer battery casing or box. These four apertures are the only openings in the outer casing. The illustrations show the details of the battery. Each couple forms a separate battery, and the two batteries are connected in series, furnishing from 3 to 4 volts. A single charge of battery is said to last on continuous work for about 8 to 10 hours. Only enough solution is put into each division to fill it about one-third, so that when the battery is in its normal position, as shown in the cut, the liquid is not in contact with the zinc element. In order to generate current and produce light in the lamp, it is simply necessary to reverse the position of the complete battery, that is, turn it on its pivot, and the liquid is then brought into contact with both the zinc and positive electrodes. The solution used consists of a mixture of water, sulphuric acid and mercury bisulphide. A small automatic valve is placed at the side of the jar, as shown in the illustration, for the admission of air into the battery divisions. The complete outer casing measures 3½x4x2 inches and weighs less than one pound.

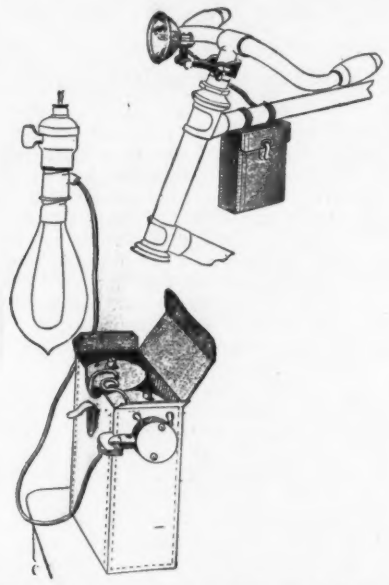
The Acme Electric Lamp Company, 1659 Broadway, New York City, showed an exceedingly ingenious bicycle lamp, in which the current was derived from a set of four small dry batteries, connected in series. The lamp consists of a highly nickeled outer box, or casing, measuring 2¾x3½x2¾ inches, and is provided with a hinged wooden cover on top, which is fitted with a multiple contact switch. In front of this casing is a small incandescent lamp of 2 cp, placed in front of a reflector and protected by a suitable glass. In the wooden cover a small, variable resistance is placed, connected to the switch before mentioned, and upon closing this cover a spring on the under side thereof makes con-



The Acme Lamp.

tact with the inner electrode terminal of the battery. The switch arm is connected with the outer casing, and in moving the switch arm over the various contact points, more or less resistance is thrown in series with the lamp. The battery gives 5 volts, and is guaranteed to run the lamp for eight hours. The Acme Company also makes similar lamps for other purposes, including a large road wagon lamp outfit, the lamp of which has a greater illuminating power and lasts from 45 to 50 hours. The same number of batteries are used, but are of larger capacity.

A very compact and light storage battery outfit was shown by the Lecoll Storage Battery Company, Chicago, Ill., under the name of the Lumino electric bicycle lamp. This storage battery consisted of two small cylindrical cells, encased in a leather casing, with suitable cover. These cells are connected in series and supported in the leather casing by straps, in the forepart of the bicycle frame. An ordinary flexible cord conducts the current from the battery to a small incandescent lamp, mounted in a reflector-holder, and is supported on the regular lamp support hook on the bicycle. It is stated that this battery is built



The Lumino Storage Battery Lamp.

upon entirely new principles, and that the two cells give 5 volts. The electrodes are not of the usual plate form. In charging the battery, it can either be connected in series with an ordinary incandescent lamp, by means of a special charging connector, furnished with the outfit, or it may be charged from an ordinary primary battery of sufficient capacity. It is claimed that this battery will run 10 hours with a single charge, and deteriorates but very little in general use.

The lamp shown by the Wizard Manufacturing Company, 340 Dearborn Street, Chicago, while not strictly an electric lamp, is mentioned here because it uses a product of electricity, calcium carbide, which generates the gas which is used as an illuminant. It certainly possesses many interesting features. The lamp consists of a lower chamber, in

Acetylene Gas Lamp.

which a piece of calcium carbide is placed. Immediately above this is a receptacle containing a small amount of water. The action of the water on the carbide generates acetylene, as is well known, and this gas then passes to the burner in front of the necessary reflecting devices in the upper part of the lamp. It is stated that the cost of operating the lamp is less than one cent per hour, and that the lamp will run six hours and over with a single charge, giving a flame of extraordinary candle-power as compared with other bicycle lamps. This exhibit attracted universal attention.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 24 1897.

ELECTRICAL STOCKS.—The general tendency of these securities is downward, and the market is decidedly weak. Most all the changes in quotations are lower, although no great drop is recorded in any one instance. Electric Storage Battery, both common and preferred, are fractionally lower. General Electric and Westinghouse securities remain practically unchanged since our last quotations were made.

TELEGRAPH AND TELEPHONE.—American Bell Telephone stands well at the head of the advances, which were general in this list of securities. The advance recorded at the time we closed our quotation list was 7 points over last week's quotations. On Friday of last week the price reached 227, which was a gain of 10 points, and was due, it is stated, to the anticipation of a favorable decision in the Berliner case and a very favorable annual report. The former influence, however, is entirely of a speculative character. Another report in this connection is that another issue of stock is looked for, and the stockholders will be asked at the annual meeting next month to authorize the same. Commercial Cable stock closed on Wednesday 10 points higher than it was at the time of last report. Western Union is also gainer to the extent of 1 point.

ELECTRIC TRACTIONS.—There was a general dullness in this class of securities, the majority of quotations being lower than they were at the time of our last report. The only exception to the general weakness was Worcester Traction, which is 1 point higher. The bond list is practically unchanged as to quotations.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	104⅝	105
" " " Brooklyn	100	..	97
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	25½	26¼
Electric Storage, pref	100	27¾	28½
General Electric	100	34⅜	34½
General Electric, pref	100	73	75
Westinghouse Consolidated, com	50	24	25
" " pref	50	50¼	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	108	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	95⅛	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	224	224½
American District Telegraph	100	29	39
American Telegraph & Cable	100	85	90
Central & South American Telegraph	100	124	127
Commercial Cables	100	160	172
Erie Telephone	100	67	68
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	82⅝	82⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18	18¼
Brooklyn Rapid Transit	..	21	21½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	68	72
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	39	42
Hestonville	100	49½	50¼
" pref	..	..	62½
New Orleans Traction	100	..	10
" " pref	100	..	35
North Shore Traction	100	20	23
" " pref	100	77	80
Rochester St. Ry	..	18	22
Steinway Ry	..	45	50
Union Railway (Huckleberry)	..	98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	66	66½
" " pref	100	91	91½
Worcester Traction	100	20	22
" " pref	100	95	98
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	80⅝	..
Buffalo St. Ry. 1st con. 5s	100	*107	110
Cleveland Elec. Ry. 1st mtge. 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	*101	104
*Westchester Electric 1st mtge 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 24, 1897.

IN NEW OFFICES.—The Westinghouse Electric & Manufacturing Company has moved its offices from the third floor of the Equitable Building, 120 Broadway, to larger and better-lighted ones on the fourth floor of the same building. The new offices are on the north side of the building overlooking Cedar Street.

ECONOMY OF ELECTRIC POWER ON THE BROOKLYN BRIDGE.—Vice-President Henriques, of the Bridge Trustees, is authority for the statement that the introduction of electric power for the switching of trains on the Bridge resulted not only in improvement of the service, but in a saving of $10,000 a year in operating expenses as compared with similar service by steam locomotives.

OUT-OF-TOWN VISITORS.—Among the out-of-town visitors who registered at the headquarters of the National Electric Light Association during the week ending Feb. 19 were the following named gentlemen: Messrs. A. M. Young, Waterbury, Conn.; H. B. Cram, Boston, Mass.; Prof. Louis Duncan, Baltimore, Md.; Charles E. Bibber, Boston; C. H. Watson, Mattewan, N. Y.; C. E. Newton, Hartford, Conn.; M. J. Perry, Providence, R. I.; H. A. Wagner, St. Louis, and H. W. Wheeler, Boston.

SUBWAY EXPLOSION.—On Feb. 21 an explosion of gas in a subway of the East River Electric Light Company occurred at 24th Street and First Avenue. As a result, the Belgian block and asphalt pavement, for a space of 30 feet around the manhole, was torn up and a heavy street car rail was sent flying through the air. Two persons were injured. Gerald Cruise, three-year-old son of Policeman Cruise, was taken to Bellevue Hospital with what appeared to be a fracture of the skull. William Ensalman was slightly injured by flying stones. The manhole in which the explosion occurred was of the closed pattern, and the upheaval was so great as to scatter the pavement in all directions.

PITTSBURG NOTES.

PITTSBURG, PA., Feb. 20, 1897.

DIVIDEND.—The Central Traction Company has declared a dividend of 75 cents per share, payable forthwith.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that the interest on the scrip of the Company, due March 1, will be paid on that date. Scrip books closed on Feb. 24.

MR. JAMES A. RUTHERFORD has accepted an important position with the Johnson Company, Lorain, Ohio, and Johnstown, Pa. Mr. Rutherford has been long identified with the railway department of the Westinghouse Electric & Manufacturing Company, and for the past year or two has had charge of the Cleveland office of that company.

THE HOMESTEAD & HIGHLANDS STREET RAILWAY COMPANY has filed, in the State Department, at Harrisburg, notice of an increase in its capital stock from $200,000 to $400,000. The road will be extended from Munhall, its present terminus, to McKeesport, thus making the second direct trolley line between Pittsburg and McKeesport.

MR. GEORGE H. LEWAR has resigned the position of assistant treasurer of the Westinghouse Electric & Manufacturing Company to accept the post of general manager of the Curtis Publishing Company, Philadelphia. Mr. Lewar has been connected with the Westinghouse interests for many years, being formerly at the New York office. He has been located in Pittsburg for the last two years, and has made many friends, whose good wishes will follow him to his new field of action.

MR. MORRIS W. MEAD, Superintendent of the Bureau of Electricity, has submitted his annual report to Director J. O. Brown. The report indicates that Mr. Mead's department has kept pace with modern improvements, and states that Pittsburg now has the most complete storage battery system in the country applied to fire alarm and police signal service. At present the bureau has 22 fire alarm circuits and 10 gong circuits, operating 395 fire alarm boxes and 93 police telegraph boxes. The storage batteries will be charged from the dynamos of the electric lighting plant in the building. Referring to the placing of wires underground in the business portion of the city, Mr. Mead states that councils have extended the time limit to Nov. 15, 1897. The Postal Telegraph and the Central District & Printing Telegraph companies have finished their required underground work, and the Western Union Company expects to have all its wires in the specified district buried this Spring. The Allegheny County Light Company will complete its share of the work next Summer. About 1,000 miles of wires have been removed from the streets, and by next Fall all of the downtown streets will be cleared.

THE HOME TELEPHONE COMPANY.—At a meeting of a sub-committee of the Corporations Committee of Councils, held on Feb. 19, the ordinance granting franchises to the Home Telephone Company came up for consideration. The Company was represented by its attorney, Mr. P. H. Adams, and Mr. John Campbell, manager. The ordinance prohibits the Company from selling its franchise, and fixes the maximum rates to be charged for telephone service at $48 per year for business houses and $36 per year for residences. Construction must be started not later than May, 1897, and must be pushed to completion as rapidly as possible. The Company is furthermore required to place not less than 1,000 telephones per year for a period of three years, beginning May 30, 1897, and a bond for $25,000 must be placed in the hands of the City Attorney for the faithful performance of the requirements of the ordinances. The top cross arms on all poles erected by the Company are to be devoted to the city's use, and all city buildings on the route of the Company's lines are to be provided with free telephone service. The ordinance was approved by the sub-committee, and will next come up for action by the general committee on corporations.

St. Louis Notes.

St. Louis, Mo., Feb. 22, 1897.

HAVE AGREED TO APPORTION COSTS.—All but one of the light and power companies, which had applied for conduit space, announce that they have agreed to divide the cost of building the joint conduits, according to the number of ducts obtained by each.

TO BE MADE ELECTRIC.—Charles Green, President of the People's Railroad Company, has returned from New York with the information that arrangements have been completed for changing the motive power of the line from cable to electricity. The work will be commenced at once.

SHAVED DOWN.—A petition was filed in the County Court recently to reduce the amounts asked in the original petition in relation to the suits against the St. Louis & Kirkwood Electric Railway, growing out of the accident on the line last May. The request was granted, and judgment by consent obtained. This indicates that a compromise has been effected.

SUBWAY FRANCHISE.—The Home Telephone Company has asked the City Council for a subway franchise, expiring in 1940, the city to have the privilege of purchase after 15 years. The ordinance follows the provisions of the Keyes bill very closely. The company agrees to complete its conduits by Jan. 1, 1899, and not to charge customers a greater price than is charged by other companies at present.

REDUCED FARES.—The Belleville Electric Railway Company, running between East St. Louis, Ill., and Belleville, Ill., has decided to sell 50-ride tickets for $1.50 (3 cents a ride) to men and women who are engaged in the trades. This is done on condition that a certificate is signed by the employer of the purchaser of the tickets, and will be good only between 5 and 8 o'clock in the morning, and 5 to 7 o'clock in the evening.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY has done a big business in the supply line the past week. It has sold 80,000 pairs of "electra" alternating current carbons, and also 60,000 pairs of high-tension arc carbons, as well as 40,000 pairs American cored carbons. All these were sold to one concern on a yearly contract. It has also supplied a lot of material to Mexico. The contract for all the overhead equipment for the Pittsburg & Frontenac Railway Company, at Pittsburg, Kansas, has also been awarded to this company.

MOTIVE POWER OF THE BROADWAY CABLE MAY BE CHANGED.—It is reported that the motive power of the Broadway cable road may be changed from cable to electricity, and if it is done, the cable conduit will not be taken up, as it may be used for carrying wires, and it is barely possible that they may rent space in it to other wire-using corporations. The conduit is 13 miles long, running through the business portion of the city. It is 18 inches wide and 36 inches deep, and has a carrying capacity of hundreds of wires.

Pacific Coast Notes.

San Francisco, Cal., Feb. 13, 1897.

NEW ELECTRIC RAILWAY.—Redding, Cal., is to be connected with Keswick by an electric railroad 8 miles in length. The Shasta County Supervisors have been petitioned for a franchise for that purpose.

VISALIA TRANSMISSION.—Work is to be resumed on the Kaweah Power & Water Company's power ditch, with the intention of completing the same by July. Power will then be transmitted from the Kaweah River to Visalia, Cal., a distance of twenty miles, for lighting and manufacturing purposes.

TELEPHONE EXTENSIONS.—The Sunset Telegraph & Telephone Company will, according to Tacoma advices, spend this year about $75,000 in Washington in improving its long-distance lines. A new line is projected across the Cascade Mountains connecting Tacoma directly with Spokane and Eastern Washington.

THE BIG CREEK POWER COMPANY is duplicating the electric equipment of its power station and lines for the transmission of current to Santa Cruz, Cal. The work will be completed in time to operate the street cars in Santa Cruz early in March. The railway generators will be driven by a Westinghouse 250-hp alternating motor. Henry Wilsey is the president of the above Company.

ELECTRICAL WORKERS DANCE.—Local Union No. 6, National Brotherhood of Electrical Workers, gave its second annual ball, at Odd Fellows' Hall, San Francisco, Feb. 6. F. N. Dodge was chairman of the Committee of Arrangements. The hall was artistically illuminated. Many special electrical features were introduced, which added much to the novelty of the occasion. The whole affair was a great success.

THE GENERAL ELECTRIC COMPANY has closed contracts for the following equipments: To the Petaluma (Cal.) Electric Light & Power Company, a 90-kilowatt alternator and a 500-volt power generator of 75-kilowatts. To the Diamond Hill Gold Mines, Ltd., Col. Tom Ewing manager, a 3-phase alternating generator of 500-kilowatts capacity. It will be driven by a Pelton water wheel and will operate stamp mills, etc.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY recently made the following sales: A 37½-kilowatt alternator to the Cloverdale Electric & Water Company (operated by steam); a 500-volt power generator, of 150-kilowatts capacity, to the Stockton Gas & Electric Company; a 100-hp 500-volt generator to the Sumdum Chief Mining Company, Alaska. With this equipment go a 75-hp motor, several small motors and a 30-hp mining-hoist, having a special commutator-type controller.

OPPOSED TO LOW FARES.—The street railway employees of San Francisco recently held a meeting to discuss the bill now before the Legislature to reduce fares to two and one-half cents between certain hours. They finally delegated a committee to present to the Legislature a petition, containing 3000 names, representing that the 5000 street railway employees of San Francisco and vicinity would be injured by reductions in wages or loss of positions, should the bill become a law. It is said that many of the companies would be forced to stop running cars.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Feb. 21, 1897.

COL. S. G. BOOKER, manager of the Phoenix Carbon Company, St. Louis, passed through Chicago on a flying business trip this week. The Colonel secured some nice orders during his short visit in Chicago.

THE CHICAGO ELECTRICAL ASSOCIATION.—The next meeting of the Chicago Electrical Association will be held on March 5, when Mr. Kempster B. Miller will read a paper on "Electrical Resonance."

MR. F. D. SWEETEN, of the C. & C. Electric Company, New York City, was in the city this week, and was ably representing his company in an endeavor to secure a large order for motors from R. R. Donnelley Sons & Co.

BANQUET.—A banquet was held on Feb. 18 at the Union League Club under the auspices of the Electric Banquet Committee. The following named gentlemen were present: B. J. Arnold, F. B. Badt, W. E. Baker, Chas. H. Besley, J. R. Chapman, Thos. H. Creden, E. B. Chandler, Max Eichberg, Prof. Elisha Gray, Charles E. Gregory, W. L. Githens, Angus S. Hibbard, W. S. Hine, Samuel Insull, Martin J. Insull, A. L. Ide, W. A. Jackson, W. A. Kreidler, W. J. Lloyd, S. J. Larned, Charles Munson, John B. O'Hara, Charles T. Page, R. E. Richardson, B. E. Sunny, Frederick Stevenson, C. H. Sewall, A. S. Terry, Henry S. Towle, A. D. Wheeler, J. B. Wallace. Several other gentlemen expected to grace the occasion with their presence, but were detained for various reasons. The banquet was a very enjoyable affair and gave occasion to renew old acquaintances and make new ones. Everybody was so well pleased with the arrangements and with the spirit of the enterprise that a vote of thanks was given to Mr. F. B. Badt, the secretary of the Banquet Committee, and he was instructed by a unanimous vote to send out invitations for another banquet on the second Wednesday in May. Prof. Elisha Gray acted as toastmaster, with his usual grace and humor. The following named gentlemen comprised the Banquet Committee: B. E. Sunny, Charles A. Brown, Samuel Insull, W. H. McKinlock, Angus S. Hibbard and F. B. Badt.

English Notes.

(From Our Own Correspondent.)

London, Feb. 10, 1897.

METHODS OF CHARGING FOR CURRENT.—As the "Wright" Demand Meter, or the Brighton method of charging for current, as it is variously called, is by now well-known to your readers, I will not describe it, but will merely remark that it is now proposed at Brighton to charge only 7d for the first hour of the maximum supply, and only 1½d for every subsequent unit, making the average charge for the Board of Trade unit at Brighton about 3¾d.

THE WILLANS ENGINE.—The speech of Mr. Mark Robinson, the Chairman of Messrs. Willans & Robinson, Ld., at the last meeting of that company, contains some very interesting figures relative to the growth in output of engines from the works of that firm, at Thames

Ditton. In 1893 the engines turned out amounted to 18,900 IHP. Two years later the orders had reached the rate of 27,900 IHP per annum, and to cope with this great increase in demand, extensive new shops and machinery had been erected. Last year the total number of orders attained the astonishing figure of 43,500 IHP, and, in order to handle the still growing rate of orders, the company now proposes to extend its shops so as to enable it to turn out an annual total of 60,000 IHP. When it is remembered that the bulk of the engines manufactured by this firm are used either for electric supply, electric traction or for driving dynamos in private electric light plants, it will be seen what an enormous amount of work has been done in this direction by this one firm alone.

THE MORDEY INDUCTOR ALTERNATOR.—A new alternator of the inductor type is now being manufactured by the Brush Electrical Engineering Company, at its Falcon Works, Loughborough. This alternator is based upon the invention of Mr. W. M. Mordey, dating some years back, which, however, has been improved in some of its mechanical features. Some tests made on a machine of this type, at Loughborough, recently, showed that the exciting current at full load is 1 per cent. of the output, at half load it is ¾ per cent. of the full output, and when running idle it is ½ per cent. of the full output. The variation in volts when the entire load is suddenly thrown off is said to be only 3½ per cent. It is not intended, I believe, to displace the original Mordey alternator, having moving field coils, but to introduce the new inductor type as an alternative pattern, which has special conditions for certain classes of work. As at present made, the inductor pattern is arranged for only one-half the frequency of the other alternators, viz., 50 periods per second. It can also be very conveniently wound for two or three-phase currents.

LONDON ELECTRICAL CAB COMPANY.—The statutory general meeting of this company, which was formed in November last, was held on Friday. The chairman of the meeting made a very plausible and moderate statement to the shareholders, stating that he did not think there was any future for private electric cabs, in view of the skilled labor required in the charging and management, and the maintenance of the electric machinery. On the other hand, in view of the excellent paved roadways which are to be found in most parts of the metropolis, he thought there was a big opening for electric traction, as applied to hackney cabs. He said that a large number of different kinds of accumulators were now under test, under conditions likely to obtain in actual work, and that, meanwhile, they had ordered a number of Faure-King cells from the E. P. S. Co. for the equipment of the 34 cabs which they hoped to have on the market within the next three months. Already the company appears to have given the go-by to the change ratio system of altering the speed of the cabs (the system which it made so much of in the original prospectus), and has adopted the series-parallel control device, to which the chairman attributes "the huge success" of electric traction in America.

THE LIVERPOOL OVERHEAD RAILWAY.—From the last half-yearly report of the Liverpool Overhead Railway Company, covering the six months ending Dec. 31, 1896, it appears that the excellent results hitherto obtained on this line have been still maintained. The traffic returns show an increase in the train mileage from 313,010 to 320,993, and the total number of passengers carried in the six months was 3,919,134. It is probable that to some extent this increase in traffic has been caused by the opening of the extension of the line, which took place last December. The financial returns show also very good results. The revenue per train mile has increased from 23.9d to 24.5d, and the total expenditure per train mile has increased from 15.1d to 15.6d, so that the ratio of expenditure to receipts is practically the same as before, and is equal to 63.8 per cent. About 23¼ per cent. of the total expenditure, representing 3.6d per train mile, has been due to power station expenses, and the fuel has cost 0.52d per train mile, that is to say, about 3 per cent. of the total expenditure. It has been ascertained by Mr. S. B. Cottrell, the chief engineer of the line, that about 4.29 kilowatt-hours are generated per train mile, so that the cost of fuel on this line amounts only to the exceedingly low figure of 0.12d per kilowatt-hour generated. The present length of the line is 6 miles 57 chains, the recent extension being 53 chains in length. The line is, of course, double track throughout, and has numerous stations. The rolling stock now consists of 42 motor coaches, and the total capital expenditure on the line, power house, etc., has been, up to the present time, £707,829 17s.

CANADIAN NOTES.

OTTAWA, ONT., Feb. 19, 1897.

MESSRS. AHEARN & SOPER, of this city, have been awarded the contract for equipping the electric railway between Montreal and Lachine.

GOOD RESULTS.—The annual statement of the Citizens' Light & Power Company, Montreal, shows a net profit for the year of $12,000 on a capital of $200,000. The Company has 15,000 incandescent lights in operation, as compared with 800 a year ago.

General News.

NEW INCORPORATIONS.

THE GOLDEN ELECTRIC COMPANY, San Francisco, Cal., has been incorporated by F. C. Cross, George E. Whitaker and C. M. Cross, with a capital stock of $50,000.

THE ELECTRIC BRICK COMPANY has been incorporated at Washington, D. C., with a capital stock of $100,000. Franklin Herr, Hannibal D. Horton and William A. Bantz are interested.

THE GUARANTOR ELECTRIC COMPANY has been organized at Trenton, N. J., for the purpose of manufacturing electrical apparatus of all kinds. The capital stock of the company is $2,000.

THE ROCKAWAY ELECTRIC RAILWAY COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $250,000. The directors are Joseph McClean, George F. Kellar and Cornelius Connelly.

THE PIKESVILLE, REISTERTOWN & GLYNDON ELECTRIC COMPANY, Towson, Pa., has filed articles of incorporation. Those interested are Edmund T. Mudge, H. D. Naylor and Arthur A. Rich. Capital stock, $25,000.

THE CITY & SUBURBAN TELEPHONE COMPANY, New York City, N. Y., has been incorporated with a capital stock of $100,000. The incorporators are Alfred H. Teller, Charles B. Minshull, Charles A. Teller and G. Rowland Monroe, of Brooklyn; Henry B. Oakman and Samuel Bear, of New York City, and Charles E. Tompkins, of Jersey City.

TELEGRAPH AND TELEPHONE.

THE ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 165 subscribers in January. Total number connected Feb. 1, 21,554.

DIXON, ILL.—The Lee County Telephone Company will extend its lines to Sterling, and the work will be pushed to completion as rapidly as possible.

GERMANTOWN, TEXAS.—A telephone line from this place to Cuero has been completed, thus giving connection with various cities in this part of the State.

WASHINGTON, D. C.—Senator Lodge has introduced an amendment to the sundry civil appropriation bill, providing for the appropriation of $25,000 to take soundings between the Hawaiian Islands and Japan, to determine the most practical route for a telegraph cable.

BELLEVUE, OHIO.—The Sandusky Telephone Company has been granted a franchise in this place to operate an exchange here. The Sandusky Company is now extending its line to Venice and Castalia, and from the latter place the Bellevue line will be run.

IRON MOUNTAIN, WIS.—The Michigan Telephone Company, it is stated, will soon construct a toll line from Iron Mountain to Menominee by way of Powers, and connecting with Norway, Vulcan, Stephenson and other places. The Crystal Falls line will be completed to Republic, which in turn connects with Marquette. This toll line will compete with the Marinette-Marquette line.

RUSHVILLE, IND.—The Co-operative Telephone Company has decided to extend its lines to Carthage by way of Arlington. At Carthage connection will be made with the line to Knightstown, thus giving Rushville telephone service to various places in Henry and adjoining counties, over the different mutual telephone systems. The Co-operative Company has a branch line to all parts of the county and will build others.

NEW YORK CITY, N. Y.—The City & Suburban Telephone Company, which was organized on Feb. 19 last, will, according to Mr. G. Rowland Monroe, one of the incorporators, build and operate lines to and from New York, Albany, Brooklyn, Buffalo, Schenectady, Amsterdam, Fonda, Fort Plain, Little Falls, Utica, Rome, Ogdensburg, Syracuse, Watertown, Oswego, Monticello, Binghamton, Auburn, Elmira, Geneva, Corning, Rochester, Olean, Batavia, Lockport and various smaller towns and cities throughout the State. Mr. Monroe also stated that the new company has purchased the rights, appliances and goods of the Make and Break Telephone Company, Philadelphia, Pa., for the State of New York. The Make and Break transmitter is in litigation, having been attacked by the Bell Telephone Company, who claimed the instrument as an infringement on the Berliner patent. The case is now in the hands of a referee in the United States Court, in the Seventh District.

ELECTRIC LIGHT AND POWER.

VINAL HAVEN, ME.—Vinal Haven is considering the question of putting in an electric light and water works plant.

COLLINGSWOOD, N. J.—The electric lighting committee of the Borough Council held a meeting, and decided to furnish this town with electric lights.

MUMFORD, N. Y.—Frank Hyde, of Elmira, was here a few days ago to see the village trustees in the matter of lighting the streets with electric lights.

AUBURN, IND.—The Town Council expects to put in a municipal lighting plant soon. Further information may be obtained from Mr. Milo D. Husselman, town clerk.

CHADWICK, ILL.—A direct current electric light plant is now under construction by Frank Zinnel. The contract for construction is held by H. F. Gray, the apparatus used being furnished by Fairbanks, Morse & Co.

NEWARK, N. J.—The Central Power Company's plant, on Broad Street, was damaged by fire on the night of Feb. 14 to the extent of about $10,000. After the fire several weeks ago this plant was brought into use as a temporary station, until the main works were rebuilt. The damage was chiefly among the dynamos

The Electric Railway.

YONKERS, N. Y.—An extension of the Yonkers trolley system will be built in the Spring.

DOYLESTOWN, PA.—The Doylestown & Eastern Street Railway Company has filed extensions to its route.

ROCKAWAY, L. I., N. Y.—The Rockaway Electric Railway Company will construct a double track street surface railroad, about four miles in length.

PENN YAN, N. Y.—The proposed electric road from Penn Yan to Branchport is to be built, and it is expected that work will begin in the Spring.

BROOKLYN, N. Y.—The Nassau Railroad Company is looking for a franchise to extend its road down Bay Nineteenth Street to Cropsy Avenue, and along that thoroughfare to Gravesend Beach.

SCRANTON, PA.—The Scranton Railway Company has obtained consent of the Dunmore Borough Council to extend its lines from the "Corners" along East Drinker Street to the Roaring Brook township line.

CHICAGO, ILL.—The Council Committee has approved an ordinance allowing the Calumet Electric Street Railway Company to extend its lines on Erie Avenue, from Ninety-third Street to South Chicago Avenue.

BOND HILL, OHIO.—A deed for the right of way to construct tracks, string wires and operate a street railway through the village of Bond Hill, to the Drayton Traction Company, which was filed by the Village Solicitor.

HINGHAM, MASS.—The directors of the Rockland & Abington Street Railway Company have presented a petition to the Selectmen of Rockland asking for permission to extend their tracks over Central Street, Central Avenue and Market Street to Lane's corner.

PORT HURON, MICH.—The City Electric Railway is making estimates on a new power plant. The business of the Company has grown to such an extent that these improvements have become an absolute necessity, and, according to President Canham, the Company will go into the electric lighting business, besides.

NEWTON, MASS.—The Commonwealth Avenue Street Railway Company has petitioned for permission to extend its tracks over Commonwealth Avenue, Walnut and Centre Streets. The Newton & Boston Street Railway petitioned for an extension of its tracks from the present terminus on High Street, Upper Falls to Needham.

GALVESTON, TEX.—The entire street railway system of this city was tied up on the morning of Feb. 17, by a strike among the employees. The Company recently announced that the pay of extra conductors would be reduced from 15 to 14 cents an hour, and their time would be shortened. The employees protested against this, but the Company remained firm, and a strike was the result. A committee of citizens at last report was making an effort to bring about an adjustment between the contending parties.

YARDLEY, PA.—The East Penn Traction Company has filed and recorded several new lines and extensions of its system. These will connect the principal portions of Bucks County and the City of Trenton, N. J., and portions of Montgomery, Lehigh and Northampton counties with Philadelphia, and intersect or cross practically all the street car lines of that city. They cover a territory twenty-five to thirty miles wide and fifty miles long, embracing the best populated and most thrifty section of the country tributary to Philadelphia. The Company's lines extending to South Bethlehem will also bring Bethlehem, Allentown and Easton into connection with Philadelphia by trolley. The Company expects to begin operations in the spring, and the first line to be constructed will probably be between Trenton and Philadelphia, and between Trenton, Morrisville, Yardley, Newtown and Doylestown. Mr. E. W. Meloney, of the Provident Electric Light & Power Company, has been appointed assistant general manager of the East Penn Traction Company, with headquarters at Yardley, Pa., and placed in charge of its practical operations.

Personal Notes.

MR. HERBERT A. WAGNER, manager of the Wagner Electric Manufacturing Company, St. Louis, Mo., spent a day or two in New York last week. Mr. Wagner's company is doing a large and growing business, its sales last month being one of the largest of any month since the company was established.

COL. GARDINER C. SIMS will, in a short time, cease to be connected with the Armington & Sims Engine Company, Providence, R. I. Colonel Sims has not of late enjoyed very robust health; but it is hoped that after a well-earned rest he will soon return to active service. Armington & Sims was the first firm to design a high-speed closely-governing engine for driving dynamos, and for many years it was practically the only engine of its class. Owing largely to lack of harmony in the company, the business has not, in late years, been pushed as vigorously as it formerly was. The engine, however, is still a prime favorite with electric lighting and street railway superintendents, and it is believed that the company, as recently reorganized, will soon regain for the Armington & Sims engine its old reputation. Readers of The Electrical World will join us in wishing the reorganized company the success to which the merits of its excellent engine unquestionably entitle it.

Legal Note.

STREET CAR ELECTRIC HEATERS.—On Feb. 15 in the United States Circuit Court, State of New York, at Utica, Judge Coxe handed down a decision in the suit of The Dewey Electric Heating Company vs. The Albany Railway Company. The former concern is owned by the American Electric Heating Corporation, Boston, Mass., and the latter is user of the heaters of the Consolidated Car Company, Albany, N. Y. The object of the suit was to prevent the use of a switch in combination with electric heaters for varying the amount of heat in cars, as covered by patent No. 464,247, granted to Mark W. Dewey, Dec. 1, 1891, for "Improvement in Electric Heating Apparatus." In granting the decree Judge Coxe says: "The invention consists in combining any desired number of distinct sections each complete in itself, adapted to be connected with the supply conductors in series, in multiple arc, or in multiple series with a switch for controlling these connections and an indicator operated by the movement of the switch to show how the connections stand. . . . Matters relating merely to form and location are not the essence of the invention. . . . The defendants' combination operates in substantially the same manner and accomplishes the same result as the combination of the claim."

Trade and Industrial Notes.

THE INTERNATIONAL ELECTRIC COMPANY, 76 Beekman Street, New York, has recently shipped two large induction coils to Italy for Rontgen-ray work.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, report an increasing demand among electrical manufacturers for their steel spring piano wire. This wire is said to be absolutely uniform in its temper and strength.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it is having quite a demand for its new type of station switchboards. These are finished in various styles and are shipped assembled, ready for installing, if desired.

MR. T. S. LANE, secretary and treasurer of the Electrical Exchange, 172 South Clinton Street, Chicago, says his company has just received two carloads of second-hand electrical apparatus, and is now in a position to offer special inducements to the trade.

MR. W. H. P. FISHER, so long and favorably known as one of the pioneers of the traveling force of the Hoppes Manufacturing Company, Springfield, Ohio, has been placed in charge of the Eastern office of this company, which was recently opened at Room No. 604, Girard Building, Philadelphia, Pa.

MESSRS. E. B. LATHAM & CO., 136 Liberty Street, New York, selling agents of the Tuerk alternating current ceiling fan, report the outlook for the coming season as more than encouraging. During 1896 this fan was in great demand, and there is no doubt but that the sales this year will far exceed those made last.

THE WORTHINGTON COOLING TOWER.—Henry R. Worthington, New York, has issued a special catalogue devoted to the application of the Worthington cooling tower to refrigerating machinery. These condensers, it is stated, save in actual practice from 85 to 95 per cent. of the water required for condensing and cooling purposes in refrigerating and ice making plants.

THE BALL & WOOD COMPANY, 120 Liberty Street, New York, has secured the contract for the installation of two of its large tandem compound engines, in the plant of the Charleston Street Railway Company, Charleston, S. C. This company is also putting the finishing touches to its installation of engines in the New York Telephone Building and Bank of Commerce Building, New York City.

STEEL WORK LET.—Contracts for the construction of an Odd Fellows' building, at Attleboro, Mass., have been let. The building will be five stories high and about 70 feet square. The interior construction supporting the floors will be steel girders, resting on steel columns. The contract for furnishing and erecting the steel work has been let to the Berlin Iron Bridge Company, East Berlin, Conn.

MESSRS. T. H. REEVE & CO., 748 George Street, Sydney, N. S. W., have just started an electric branch of their business as ironmongers, and are desirous of receiving trade catalogues from reliable makers of telephones and electrical supplies in general. All American manufacturers in these lines are invited to send forward their catalogues to this house. There is here a chance to develop some business.

MESSRS. J. C. STERNS & CO.—The business for many years known as The F. P. Jones Company, 255 Pearl Street, Buffalo, N. Y., has been dissolved by mutual consent, Mr. J. C. Sterns and Mr. Walter Cary having purchased the interest of Mr. F. P. Jones. The firm will hereafter be known as J. C. Sterns & Co., and will deal in all kinds of electric supplies and do electric work of every description at the old stand.

BALL ENGINES.—An electric light plant has lately been placed in the Wauwatosa County Insane Asylum, Wisconsin. The Ball Engine Company, Erie, Pa., furnished the engines. The direct connected engines and dynamos for the Chicago Public Library are now being put in position. The Chicago Edison Company furnishes the dynamos and the Ball Engine Company, Erie, Pa., the engines. The plant consists of 5 direct connected sets, amounting to 900 hp.

MR. MORTIMER NORDEN, formerly associated with Miner & Co., electrical contractors, New York City, has opened an office at 39 Cortlandt Street, and intends to devote himself in the future particularly to consulting work. Mr. Norden has had a large experience in electrical work, and has made a specialty of theatre installations. Some of

the new work lately completed under his supervision includes the Metropolis Theatre, Volks Garden, Murray Hill Theatre, and Huber's Museum, New York City, and Taylor's Opera House at Trenton, N. J.

THE ELLIPTICAL CARBON COMPANY, Chicago, Ill., reports that the sales of its product are very satisfactory. Many central station managers, it is reported, have found it advantageous to throw away their carbon holders in order to use the Ellipticals, and many others have the matter under consideration. Mr. Charles E. Gregory, the manager, states that it is only a matter of time when his company will be compelled to increase its present facilities in order to supply the constantly increasing demand for these carbon holders.

BERGMANN ENCLOSED ARC LAMPS.—An artistic catalogue just issued describes and illustrates the 1897 styles of Bergmann long-life enclosed arc lamps, manufactured by the General Incandescent Arc Light Company, First Avenue and 33d Street, New York City. The catalogue is handsomely printed in two colors in antique style, and the illustrations of the various designs of lamps are excellent specimens of the engraver's art. At the back is given an illustration of the company's factory. Mr. R. B. Corey is the general sales agent for this company.

CATALOGUE OF SHAPERS.—Messrs. Gould & Eberhardt, Newark, N. J., have issued a catalogue illustrating and describing Eberhardt patent shapers. These machines are built in several styles. They do the work much quicker than planers, occupy less room and are more easily operated. The shaper is acknowledged to be one of the most useful tools in a machine shop, and Messrs. Gould & Eberhardt are said to be pioneers in the building of machines of this class. They keep ahead of the times and provide every improvement in their machines that experience dictates as necessary.

THE MASON ELECTRIC EQUIPMENT COMPANY, 1202 Fisher Building, Chicago, Ill., in a circular just issued to the trade illustrates a line of electric railway overhead devices, which the Company recommends for their standard of excellence. Their mechanical and electrical construction are claimed to be the highest ever attained. The Company deals in electric railway supplies exclusively. Its line hangers are all fitted with a locking device, making both hanger and insulator practically indestructible. The Company handles everything for the complete equipment and maintenance of electric roads.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is offering for sale the buildings of the stove works at Sioux City, Iowa. These buildings, which comprise the foundry, mounting shop and general machine shop, were erected by the Berlin Iron Bridge Company, but owing to the failure of the stove works the structures were returned to the possession of the Berlin Company. These buildings are now offered for sale. They are really not second hand, because they have never been used. This seems to be an excellent opportunity for any company contemplating new construction to secure a plant at a small cost.

WASHINGTON'S BIRTHDAY AT THE AMERICAN ELECTRICAL WORKS.—The 165th anniversary of the birth of Washington was not overlooked by the American Electrical Works, Providence, R. I. In accordance with its usual custom of sending out souvenirs on special occasions, the American Electrical Works celebrated Washington's birthday by sending out to the trade with its compliments a very handsome little vignette steel engraving of George Washington, together with a little reminder, on a separate sheet, that the American Electrical Works are the largest makers of the best bare and insulated electric wire and cables.

FINE CATALOGUE.—The reputation established by the New York & Ohio Company, Warren, Ohio, in the matter of getting up catalogues of its Packard lamps, has been surpassed in the production of its 1896-97 catalogue. In this case the work is a little more pretentious than any of its predecessors and a good many of its pages are devoted to general data on incandescent lamps and other information of a valuable nature. The Electric Appliance Company, Chicago, Ill., has prepared a special discount sheet for the catalogue, giving the present market price on high grade Packard lamps. This discount sheet will be sent to the trade on application.

THE RODNEY HUNT MACHINE COMPANY, Orange, Mass., has noticed a large and increasing demand for equipment in the way of turbine water wheel plants, for generating and transmitting electricity for power and lighting use during the past two years, and some of the largest plants it has installed, and aggregating the largest number of horse-power in any one plant, have been along this line. This company is now at work on a plant of five wheels aggregating about 2,000 hp for an electric light and power plant in the City of Cordova, Argentine Republic, S. A., and also has under consideration the equipment for a smaller size plant of the same nature in this country, besides having under consideration several other enterprises of like character.

CARBON ELECTRODES.—Mr. Hugo Reisinger, No. 38 Beaver Street, New York, who is well known to the electrical trade through his "Electra" arc light carbons, has had great success in the introduction of his carbon electrodes, which are extensively used in the electrolytic production of aluminum, copper, chlorate of potash, etc. The carbon electrodes supplied by him are said to be made of pure carbons. They are homogeneous throughout, of the very highest conductivity, and have great life. The European factory which Mr. Reisinger represents in this country has abundant facilities for turning out large quantities of these carbon electrodes, and among others, has a running contract to supply all the carbon electrodes used in the world-renowned aluminum factories at Neuhausen, Switzerland.

WINDOW REFLECTORS.—The Frink special window reflector, manufactured by I. P. Frink, 551 Pearl Street, New York, is reported as having a phenomenal sale in cities where it has been introduced. In the large department store of William Browe & Son, in Newark, N. J., the system was installed, and, according to report from the proprietor of the store, the result has been eminently satisfactory. The windows are rendered brilliant, but at the same time the source of light is completely hidden from the observer. This installation has led to the closing of a contract for similar work in a large store in a near-by city. The Corcoran Art Gallery, Washington, D. C., was equipped throughout by Mr. Frink with these reflectors, the system being operated for the first time on Feb. 22. Mr. George Frink Spencer is manager of the house.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has been given the Western agency of the electric heating apparatus, made by Messrs. Whittingham and O'Brien. This line covers domestic laundry and tailors' irons of all kinds, electric heaters (radiators), etc. The company reports a growing demand for this class of goods, especially for electric laundry irons. The irons are arranged with a standard socket, so that all that is necessary is to unscrew the incandescent lamp, and insert the socket, which is attached to the heater, and the apparatus is ready for use. The Metropolitan Electric Company has also taken the agency of the Reynolds self-insulating bug cutout, and has a stock of these on hand, from which it can make prompt shipments. This cutout is neat and compact in form, the size being only about 3¾ inches in diameter and 1½ inches long. This, with other desirable features, makes it fill many requirements of the wiring trade.

MESSRS. CHARLES A. SCHIEREN & CO., 45-51 Ferry Street, New York, have received a letter from the Southern Electric Light & Power Company, Philadelphia, Pa., in which Messrs. J. M. Mack, president, and William J. Manning, secretary and manager of that company, speak in terms of praise of the fine quality of belts supplied to that company by this house. The Southern Electric Light & Power Company has been using Schieren belts ever since it started in business, six years ago. In fitting up its new station at Gray's Ferry Road and Carpenter Street, Schieren belts were used throughout, and have given satisfaction in every respect. This order consisted of four 64-inch three-ply belts, one 31-inch three-ply belt, and 45 dynamo belts ranging from 10 to 20 inches. On February 11, Messrs. Charles A. Schieren & Co. received an additional order from the Southern Electric Light & Power Company for two 64-inch three-ply belts, each 94 2-3 feet in length.

THE BALL ENGINE COMPANY.—The Apollo Iron & Steel Company, Vandegrift, Pa., has ordered a direct connected set for electric lighting. The engine, which is a 150-hp vertical compound, built by the Ball Engine Company, Erie, Pa., is direct connected to a 90-kw General Electric alternating machine. This Company already has an electric light and power plant, consisting of three 400-hp tandem compound engines, made by the Ball Engine Company, which are direct connected to Westinghouse generators of 225-kw each. A very complete electric power and lighting plant is now being placed in position in the extensive works of the Shoenberger Steel Company, Pittsburg. The power plant consists of one 400-hp vertical cross compound engine, direct connected to 225-kw generators, and one 175-hp vertical compound engine, direct connected to 125-kw generator. The engines were furnished by the Ball Engine Company, Erie, Pa., and the generators by the Siemens-Halske Electric Company, Chicago.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY is the new name of the company heretofore known as the Card Electric Motor & Dynamo Company, Cincinnati, Ohio. Mr. George Bullock will be president and treasurer, and Mr. J. S. Neave vice-president and secretary of the new company. Both gentlemen have long held similar positions with the Card Company. The excellent reputation of the manufactures of this company under its former title will assure the favorable reception of the new goods to be put on the market this season. Another concern, The Bullock Electric Company, in which Mr. Bullock and General Eastern Agent Robert T. Lozier are partners, has been organized to handle the sales department of the Bullock Electric Manufacturing Company east of the Alleghanies, and will move on March 1 into a handsome suite of offices in the new St. Paul Building, New York City. The company will also have branch offices in Boston and Philadelphia.

W. C. BALLDA, manager of the Utica Manufacturing & Supply Company, Utica, N. Y., has secured a contract from Hugh Glenn & Co., in that city, to place in the latter firm's stores 40 long-burning Manhattan enclosed arc lamps, which will displace the incandescent lamps now used. The Manhattan lamps will be of the 150-hour type. Of the 640 incandescent lamps hitherto used, 540 will give way to the newer light, only 100 being retained to light the basement. The new arcs are rated at 2000-cp each, and will consume no more current than was required by the incandescent lamps. Messrs. Hugh Glenn & Co., it is stated, made a thorough test of different makes of lamps, and were so well pleased with the Manhattan that they finally decided to substitute that type for the incandescents in their stores. The important features claimed for the Manhattan lamp are economy of operation, greater illuminating power, and ease of maintenance. The Manhattan lamp is connected singly, and consumes 5 amperes of current at 80 volts.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-CUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

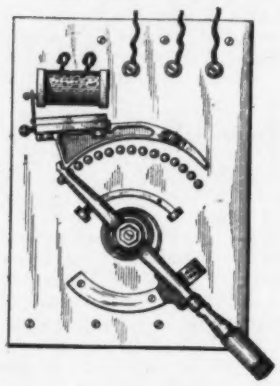
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 16, 1897.

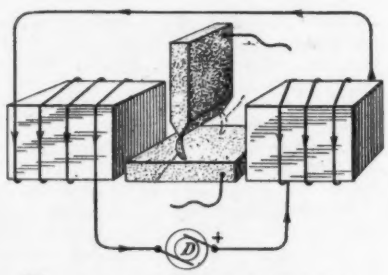
(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

577,033. ILLUMINATED SIGN; C. Holland, Millis, Mass. App. filed March 17, 1896. A frame or holder adapted to be connected with the socket of an incandescent electric lamp and having a pair of jaws and a sign-plate detachably held by said jaws.

577,037. ELECTRIC SWITCH; C. D. Jenney, Indianapolis, Ind. App. filed April 7, 1896. In an electric switch, the combination of the switch-lever mounted to swing on a pivot over a series of contact-points arranged in the arc of a circle, a locking arm pivoted adjacent to the path of the end of said lever and formed with its adjacent side substantially parallel with the arc in which said points are arranged, and of a length to extend from one end of said arc to the other so that its ends are substantially opposite terminal points



No. 577,037.
Electric Switch.



No. 577,371.—Electromagnetic Arc-Controlling Device.

of said arc, and are arranged to engage opposite sides of said lever as it reaches said terminals and lock it in position, an electro-magnet for holding said parts locked in one position, and mechanical means for holding them locked in the other position.

577,081. ELECTRIC CONTROLLER; E. A. Sperry, Cleveland, O. App. filed Sept. 21, 1896. In an electric controller, the combination of a cylinder provided with contacts for establishing various connections of the motor-circuits, brushes engaging with the contacts, and means for changing the relation between the brushes and the contacts on the cylinder by a movement of one relative to the other in a direction transverse to the plane of rotation of the cylinder.

577,101. TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 19, 1896. In a telephone the combination with the subscriber's microphone and primary of an induction coil, of an electro-thermal generator in circuit therewith, a hearing-coil in proximity to said electrothermal generator, means for supplying current to said heating-coil, and means for controlling the supply of current to said heating-coil.

577,102. PARTY LINE TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 19, 1896. The combination with an electric circuit consisting of two limbs or sides adapted to be formed into a metallic circuit, of a group of high resistance signal bells connected with the outer portion of said circuit, an inner group of low resistance signal bells included in said circuit relays, one for each limb, connected between said groups and each when operated acting to diminish the resistance of the other limb, means for sending pulsating current of either polarity over either of said limbs, and means for at the same time directing battery-current over the limb corresponding to that over which the signaling or pulsating current is being sent, to operate the proper relay, whereby either bell of the low resistance group may be operated without ringing any other bell of either of the groups.

577,119. ELECTRIC BRAKE; Elmer A. Sperry, Cleveland, O. App. filed Feb. 19, 1895. In an electric brake system, the combination of a dynamo-electric machine having a series and shunt field-coil and adapted for propelling and braking the vehicle, with means for maintaining a field magnetization at the time the dynamo-electric machine is not affecting the motion of the vehicle.

577,128. SIGNAL; P. G. Feuerstein, Milwaukee, Wis. App. filed Oct. 26, 1896. A clock having its dial provided with hour and minute contacts, the clock hands as electric conductors that travel against the contacts on the dial, a switchboard having contact wires to those aforesaid, electric-signal wires, and an electric split plug for connecting switchboard-contacts with signal wires.

577,130. SPACE-BLOCK FOR ARMATURES; H. Heisenhoner, Schenectady, N. Y. App. filed Nov. 20, 1896. A space-block for armature cores consisting of a main portion of cast metal, having recesses or seats for the teeth or projections of the space-block and teeth or projections of strips of metal secured to said cast portion.

577,141. MEANS FOR PREVENTING DESTRUCTIVE FIELD MAGNET DISCHARGES; F. Mackintosh, Schenectady, N. Y. App. filed Oct. 31, 1896. The art of preventing destructive discharge from field-magnet coils, which consists in including in circuit with the field-magnet coils and the exciter, a secondary source of electromotive force, interrupting the circuit of the exciter, causing electromotive force, interrupting the circuit of the exciter, causing the secondary source of electromotive force to energize the field-magnet coils and decreasing the secondary electromotive force.

577,148. BINDING BAND FOR ARMATURES; H. G. Reist, Schenectady, N. Y. App. filed Nov. 18, 1896. In a removable binding-band the combination of a number of turns of wire-loops formed at the end of the band, and means for securing the ends.

577,159. INCANDESCENT ELECTRIC LAMP; C. S. Dolley, R. Hawkins & T. M. Lightfoot, Philadelphia, Pa.; App. filed April 22, 1896. In an incandescent electric lamp an incandescent filament compressed between two non-conducting plates, one or both of which plates is either transparent or translucent, and from between which plates the air has been exhausted and a hermetically sealed boundary-frame for said plates.

577,214. RESONANT ELECTRIC CIRCUIT; J. S. Stone, Boston, Mass. App. filed Sept. 10, 1896. A resonant electric circuit containing inductance resulting from the magnetization of independently magnetized paramagnetic material.

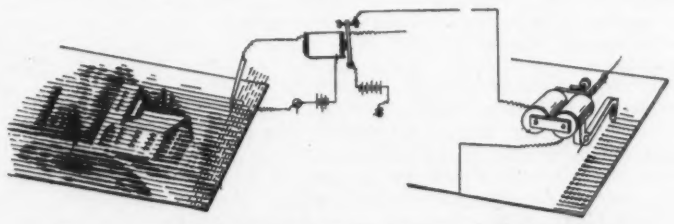
577,231. TELEPHONY; W. L. Bradshaw, Cincinnati, O. App. filed March 30, 1896. In a telephone system, a push button in combination with a receiver, a hook, a ringing battery, a line, a plate, a line spring, a drop spring and a drop.

577,233. ELECTRICAL ATTACHMENT FOR BARBERS' CHAIRS; N. H. Burger, Benzonia, Mich. App. filed Oct. 23, 1895. In an electrical attachment for barbers' chairs the combination with the chair having an adjustable head-rest slide provided with a pair of metallic guides forming contact strips for the attachment, a suitably arranged battery, circuit wire connections between the poles of the battery and said contact-strips, an induction coil fitted on the rear side of the head-rest of the chair and having a switch, said coil having two of its terminals electrically connected with said contact strips, a fixed electrode secured to the frame of the chair and having a wire connection with the coil and a movable electrode adapted to be attached to a brush or similar device and also having a wire connection with the coil.

577,270. APPARATUS FOR GENERATING AND APPLYING HEAT TO THERMOCOUPLES; H. C. Reagan, Jr., Philadelphia, Pa. App. filed April 1, 1896. A boiler provided with water tubes, fire tubes passing through the latter, a series of thermocouples supported upon said water tubes and means for holding said couples in position.

577,279. ELECTRIC GAS LIGHTER; J. T. Armstrong & A. Orling, London, Eng.; App. filed Nov. 19, 1896. In an electric gas lighter and extinguisher, the combination, with an electromagnet or solenoid, of an armature or core adapted to be lifted by said solenoid or electromagnet, which core forms the gas-controlling valve a permanent magnet that is pivotally applied to a spindle on said core or valve, and means for retaining the permanent magnet and the valve in lifted position when the circuit is broken for supplying the gas or releasing said magnet by reversing the direction of the current in said direction so as to permit the valve to drop back to its seat for cutting off the supply of gas when the circuit is again broken.

577,282. ELECTRICAL BATTERY; E. Burnet, Wigan, Eng. App. filed Nov. 30, 1895. In a battery the combination of a cell formed with a socket in its upper opened end, with the electrodes, and a tray sup-



No. 577,373.—Method of Reproducing Photographs.

porting the electrodes and closely fitting within the socket and having a flange extending over the walls of the cell to prevent leakage into the tray.

577,371. ELECTROMAGNETIC ARC CONTROLLING DEVICE; F. J. Patten, New York, N. Y. App. filed Sept. 8, 1896. The method of imparting a reciprocating movement to an arc between electrodes which consists in causing the arc to traverse a magnetic field in which the lines of force are substantially transverse to the direction of the arc and reversing or alternating either the arc-producing current or the magnetic field.

577,373. METHOD OF REPRODUCING PHOTOGRAPHS. N. S. Amstutz, Cleveland, O. App. filed April 9, 1895. The method of electrically reproducing photographs, etc., consisting first in forming a pictorial image with continuous parallel lines in the half-tone portions thereof; second, in moving in contact therewith, at about right angles to said lines, a suitable tracer whereby electrical impulses of varying duration are formed, and third, recording such impulses in an engraved manner on another surface.